POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

In This Issue

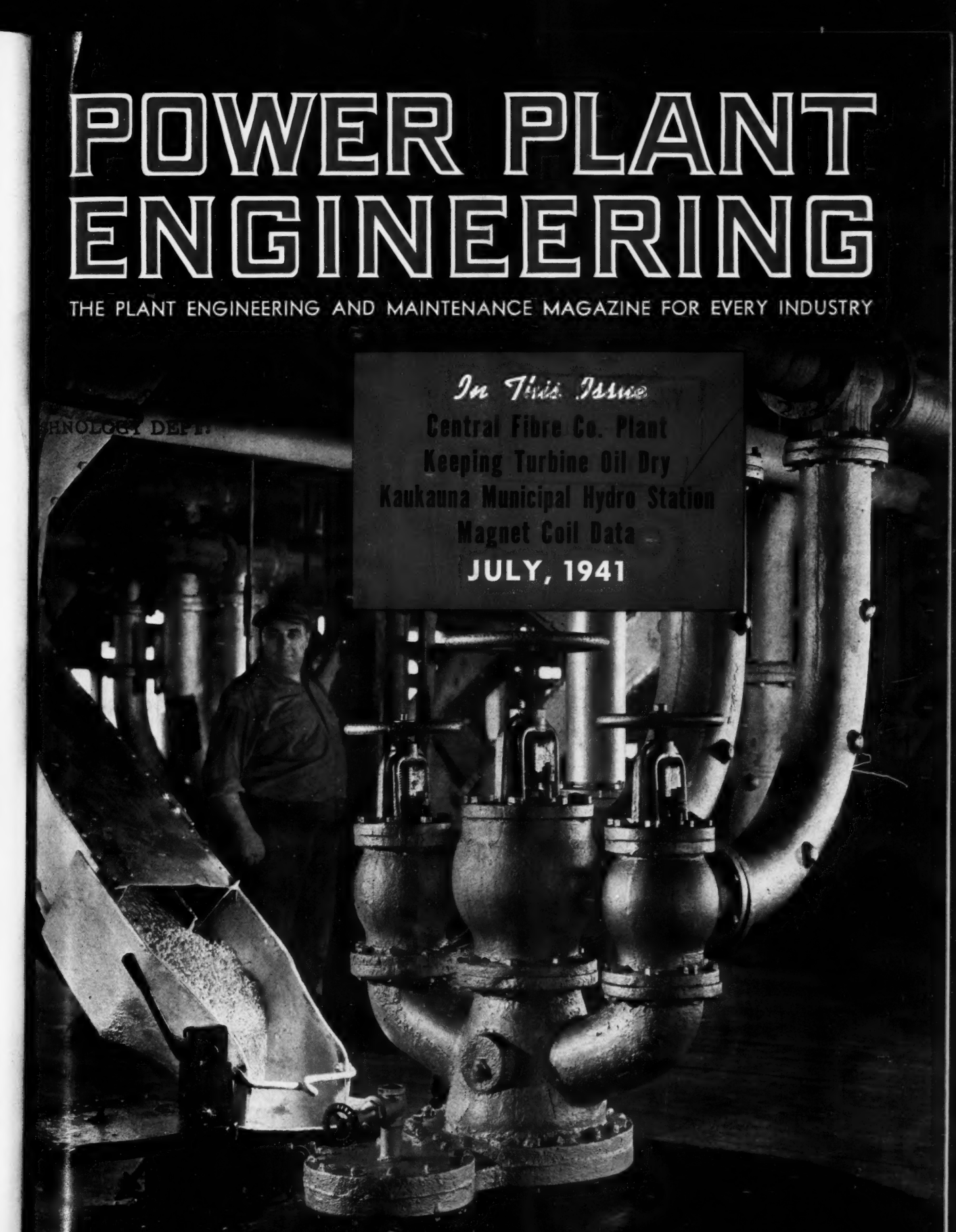
Central Fibre Co. Plant

Keeping Turbine Oil Dry

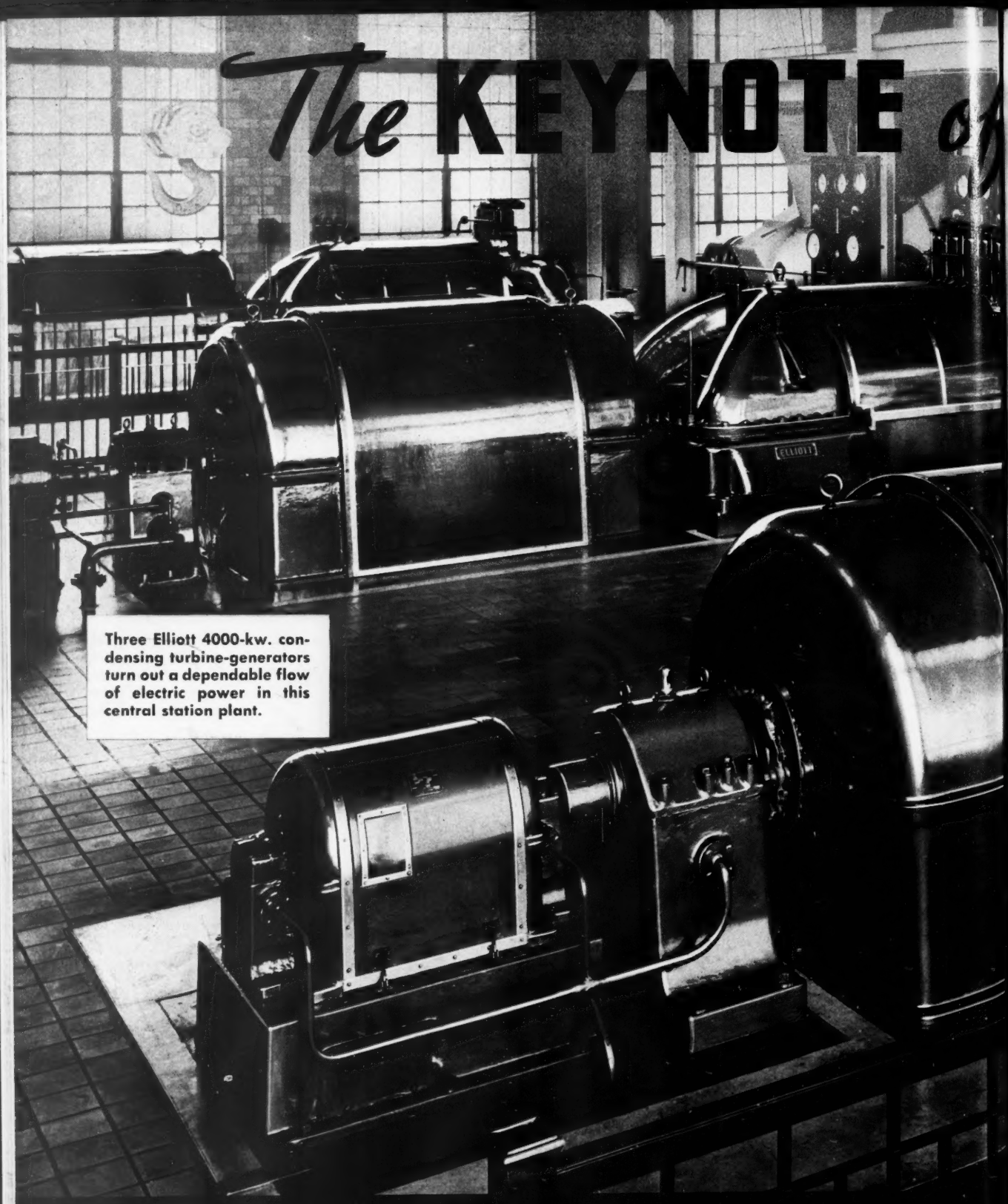
Kaukauna Municipal Hydro Station

Magnet Coil Data

JULY, 1941



Corn flowing into large steam cooker —a power service application in a corn products manufacturing plant



Three Elliott 4000-kw. condensing turbine-generators turn out a dependable flow of electric power in this central station plant.

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Cover: Flowing grain fills the belly of a steam processing tank—a step in the production of starch, sugar and hundreds of other products from corn. A typical power utilization study. Photo, Crane Co.

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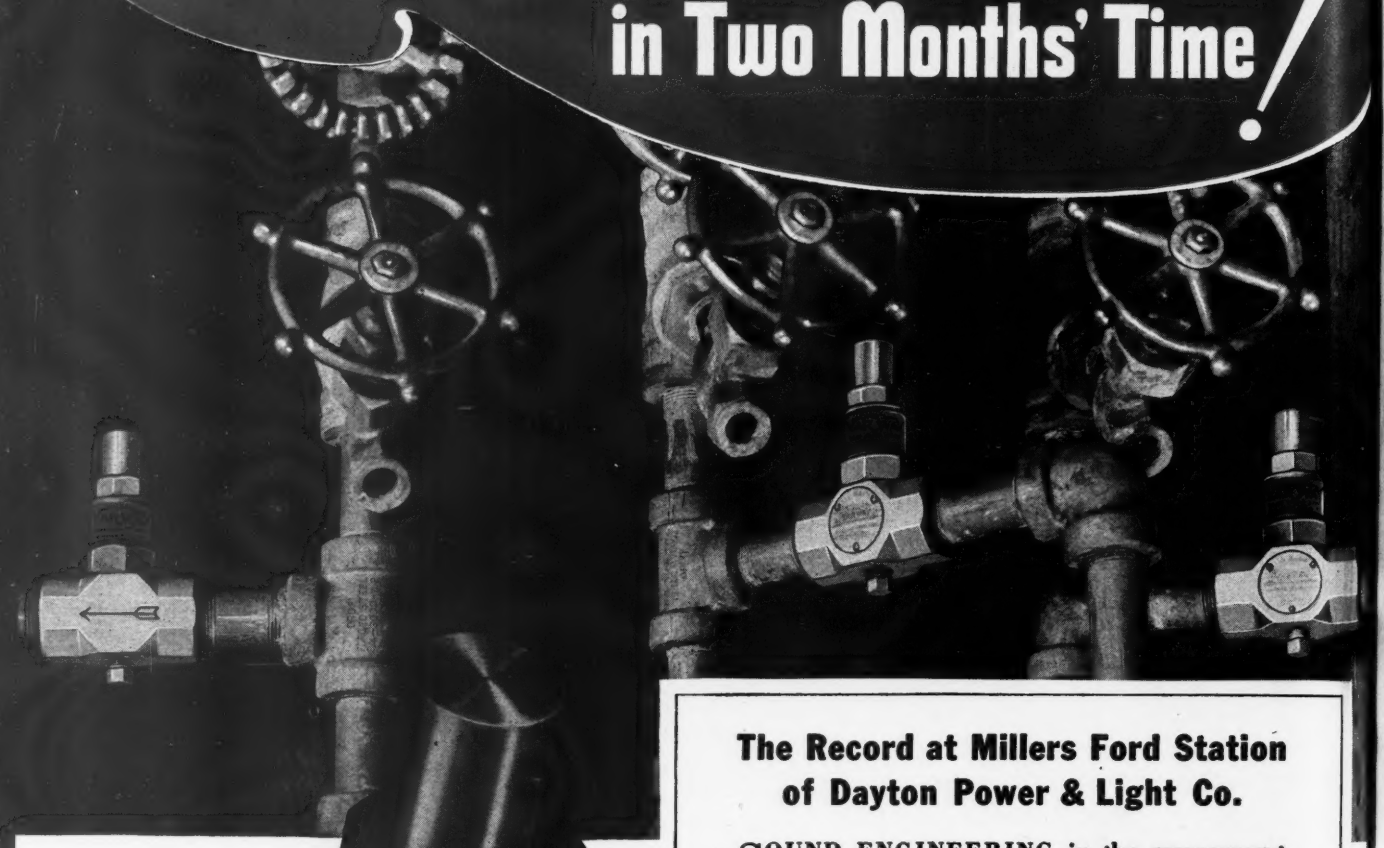

The Record at Millers Ford Station of Dayton Power & Light Co.

SOUND ENGINEERING in the arrangement for recovery of feed water, and 48 YARWAY IMPULSE STEAM TRAPS, are *saving large quantities of expensive evaporated make-up water per day* at Millers Ford Station.

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YARWAY IMPULSE STEAM TRAP

THE VOICE OF INDUSTRY

C. W. KELLOGG on the ADEQUACY OF OUR DEFENSE POWER SUPPLY

EXPERIENCE of the war in Europe has shown that modern warfare is essentially a matter of industrial production. It is gratifying to be able to report that our own construction program in this direction is well ahead of schedule and, by midsummer, we, as a nation, shall be on a mass production basis on all of the materials needed for our own protection and for aid to Great Britain.

This great industrial effort naturally requires an adequate supply of electric power, not only to turn the wheels of industry, but also to supply the needs of the great electrochemical and electrometallurgical industries. The utilities as a group have 2,103,000-kw. of new generating capacity scheduled for completion in 1941; 2,459,000-kw. in 1942 and already 827,000 and 180,000-kw. respectively in 1943 and 1944.

Adding to these figures the capacities projected by the Federal Government, District Authorities and municipalities, together with those of industrial companies, bring the totals of new generating capacity to: 1941, 4,150,000-kw.; 1942, 3,430,000-kw.; 1943, 1,046,000-kw.; 1944, 668,000-kw. The totals for 1941 and 1942, amounting to over 7,500,000-kw., are, on account of the time required for construction, fairly complete, but the 1943 figures will continue to mount. They must do so in order to serve the further developments now being formulated.

In 1938 three-eighths of the industrial energy of the country was generated by the industries themselves and only five-eighths of it purchased from central stations. It is logical therefore to include in the total of new power available the 670,000-kw. of generating capacity to be installed by industrial establishments in 1941 and 1942.

In discussing the adequacy of power supply, the elements of time, location and nature must be considered. The important question was not the actual shortage of these things so much as the adequacy of the plans to acquire them in the shortest possible period. Our military authorities have deemed it wise strategy to spread the plants for producing defense material about the country. The extent to which shortages of power may have arisen in a few areas of intensive industrial development merely emphasizes lack of flexibility in decentralizing defense effort. Power shortages estimated by public bodies have generally been at a time in the future so far away that they have been eliminated by new construction before the time arrived for their expected occurrence.

In addition to the unprecedented increases of 7,500,000-kw. in generating capacity to be added in 1941 and 1942, a great basic element of strength in the electric power situation is the ample reserves of generating capacity that have been built up over past years. Considering the most adverse conditions, there is still left a generating margin averaging perhaps 10 to 15 per cent to be drawn upon as needed.

Another unused reserve is the ability in emergency to exceed rated capacities by a margin of 10 to 15 per cent, or with hydro more, during a peak of moderate duration. A still further resource, that has so far hardly been tapped in the present emergency, is the huge increase in energy that would be available from continuous operation throughout the 24 hr. of the day for 7 days a week. This alone could add 15 to 20 per cent to the annual power output of all electric generators, sufficient to carry a further increase in industrial production of nearly 20 per cent.

While we may view with some satisfaction the totals of new generating capacity scheduled—we must realize that our orders for generating equipment would be but scraps of paper if they were not backed up by a manufacturing industry able to deliver this greatly increased output of equipment.

When, in addition to the unprecedented needs of the electric power industry, we learn that these same electrical manufacturers are being called upon to fabricate at the same time an equally large kilowatt capacity in propulsion turbines for our navy, we must realize that relatively their burdens are much heavier than our own.

It is a pleasure and a satisfaction to express to our great allies the pride we feel in their current achievements, both for the public service and for the national defense. As Mr. Bernard Baruch remarked recently: When Germany made war into a completely mechanized process, she was playing right down our alley as a nation. No part of our vast industrial system has lived up more fully to our American genius for production than have our great electrical manufacturers.

C. W. KELLOGG, first permanent president of the Edison Electric Institute; consultant to the subcommittee on Electric Power Problems of the Advisory Commission to the Council of National Defense; and now, chief consultant of the Power Unit of the O.P.M. needs no introduction to power engineers.

He knows every phase of the industry from long years of first hand experience. He has an abiding faith in the ability, integrity and future of the private utility system, and never once has he, as leader of the industry in the past few critical years, backed down from what he considered a just stand.

Nor is he bigotted, arbitrary, or uncompromising, unable to recognize accomplished fact and see all sides of the power picture. His efforts during the past year prove that he is first of all an American, one of those rare individuals big enough to be undisputed leader of his own industry without impairing his status of honest, conscientious representation of power as a whole whether it be private utility, industrial, municipal or federal.

This page is taken from Mr. Kelloqg's address to the E.E.I. at the Buffalo Convention on June 3.

Photo, General Electric Co.

Oswego Starts Second Unit

"THE RESPONSIBILITY for a public utility service entails long range planning. The first essential of this planning is to provide adequate generating capacity." ¶ With these words, Alfred H. Schoellkopf, president of Niagara Hudson Power Corporation, announced October 28, 1939, the order of a second 80,000-kw. turbine generator from the General Electric Co. to double the size of Central New York Power Corporation's new Oswego station. The first 80,000-kw. unit, ordered September, 1938, was larger than any steam driven turbine generator acquired by a utility since 1931. ¶ Materialization of the utility's long-range planning is now being realized. At this writing the second 80,000-kw. unit is being placed in service giving the station a total of 160,000-kw. generating capacity. The first unit has been in operation since September, 1940. ¶ Built at a cost of $16,500,000 Oswego station is ideally located, both from an operating and a service standpoint. Water in quantity and at the right temperature is available from Lake Ontario for condensing purposes; coal can be brought right to the station dock economically and the plant is well situated with respect to the system's transmission lines and the market into which the power is delivered. The station's two 80,000-kw. units use 1250 lb. steam at 900 deg. F. and the generators are hydrogen cooled. The entire control is centralized in one room

WITH THE EDITORS

◆ **PRIORITIES . . .** Pointers for the uninitiated: Before asking for priority aid, try other reasonable and customary means; give attention to the need for proper scheduling, one of the most important factors in the defense program; application for priority aid should be accompanied by full supporting data on the problem involved.

Although priority aid may be given to important civilian projects, it is not the policy of the Priorities Division to give such aid to non-defense contracts or projects which have no connection with the defense effort, unless unusual circumstances are involved.

Broadly speaking, priority problems which arise in the strictly military sphere may be brought first to the attention of the Army or Navy service involved; problems which are not military, or in which the connection with primary defense contracts is not clear, may be brought before the Priorities Division, Office of Production Management, Washington.

Utilities that cannot get steel for finishing plants may get assistance from the War Department or direct from O.P.M., depending upon the extent of defense contracts in the area served. Broadly speaking, National Defense includes all supplies, direct or indirect, for the Army, Navy, Maritime Commission or the Lend-Lease Program.

◆ **53 SHOPPING DAYS . . .** Largely because the defense industries will be rising toward full production this fall, with a corresponding demand on transportation facilities, various government and defense agencies plan to launch a campaign to impress upon bituminous coal consumers the importance of buying and taking delivery of their winter coal this summer.

Prices should not be out of line with last summer's prices, less the usual summer discount, and consumers are warned against panicky buying at high prices. The Bituminous Coal Division began a hearing on May 21 to redetermine production costs. If these are found to be more than two cents out of line with present minimum prices, new prices will probably be set.

Inasmuch as mine supply of bituminous coal is said to be generally ample for anticipated needs, this summer storage cannot be considered hoarding, but stocking. The present bituminous coal production capacity is said to be in excess of 570 million tons per yr. as against maximum estimated requirements of 500 million tons. No shortage of general domestic and industrial supply is anticipated, provided transportation is adequate for both coal and defense needs from September through the heavy burning season.

◆ **THE FAMILY TIE . . .** Considering past relations there is perhaps some question as to whether the TVA is really a member of the family or a rank outsider horning in uninvited on industry that was doing well under private ownership. To show that this is no time for private quarrels, however, eight of these same private utilities have recently pitched in with a will to help carry the TVA load with off peak power.

Embarrassment of the TVA in the matter of power capacity recently received considerable publicity—not all favorable. Schemes suggested for handling the problem ranged from commandeering all Diesel locomotives, to running a battleship up the Tennessee River to make up the deficiency. It seems that the TVA was hoisted by the same petard of power shortages raised by its sister agency, the F.P.C., against the private utilities.

Contrary to general opinion, the TVA was not caught with a reduction of generation below committments but by failure to foresee and anticipate rapid load growth due to defense. Power committments of 600,000-kw. are being exceeded by 25 per cent, most of the excess going to the Aluminum Co. to keep up full production in the face of reduced output from the company's own plants due to drought.

◆ **SKYROCKET . . .** They contracted for 30,000-kw. of firm TVA power. During the past 3 mo. they have been supplied 150,000-kw. and during the last month 175,000-kw. Some of this has been carried by cutting off four electric furnaces at the Muscle Shoals fertilizer plant and some by transferring outside power over the lines.

In the meantime 120,000-kw. at the new Watts Bar steam station is being pushed to completion by November instead of February as planned; and a 154 kv. tie line north into Kentucky is being rushed. Commendable efforts, but if a governmental agency cannot predict future defense loads, how can private utilities be expected to do so?

Load prediction today apparently comes down to a careful analysis plus an arbitrary addition of a few odd 30,000 and 50,000-kw. units scattered around the system promiscuously in the hopes that they will be needed. Or, if they are not needed for natural load growth, riding the rates department until the load is built up to capacity. This sounds silly on the surface but has been advanced as a serious solution of the load building problem. That is, base the installed capacity on the potential load in the district and then hustle out and sell it—pass the buck from the engineering to the sales department.

◆ **IN THE ARMY NOW . . .** Lots of power plant men are singing that now, but along the Atlantic seaboard it seems to be the Naval Reserve that is getting the cream of the crop and making really serious inroads on utility operating crews. Power is admittedly a primary essential to production. The government on one hand is making a serious attempt to guard plants against sabotage, on the other hand leaving them wide open to serious damage by inexperienced operators.

One plant directly tied in to defense with large blocks of power is running with a reduced crew and three really experienced men for the three shifts. One recently lost a shift engineer, operator and machinist in quick succession. One has had its test crew, including key men being groomed for a new station, depleted. One faces the loss of the station superintendent.

The Navy knows the good men and is going to have them in spite of hell, highwater, threats and pleadings. The local draft boards are almost as adamant. To a certain extent the utilities themselves are to blame for being slow in requesting deferment through a sense of false patriotism.

This phase has, however, pretty well passed. There is no further question as to the need for retaining skilled operators at a time when capacity is being expanded at an unprecedented rate, largely with complicated high pressure equipment that requires better than average operators.

At the present time, when industrial production is needed, trained men should be kept in the plants and it is to be hoped that a serious accident will not be needed to drive home this fact.

Fig. 1. In use, the projecting spindle of the hand-held sine wave alternator is inserted in the lathe center hole in either end of the rotor shaft

Modern Methods Of Balancing Turbines

By K. E. MOTT
Engineering Dept. Cleveland Office
General Electric Company

MISALINEMENT and abnormal wear in steam turbines can often be attributed to an unbalanced condition of the turbine, generator, or both rotating elements. Formerly, the correction of this unbalance was accomplished either by marking the shaft or by the use of quartering shots as employed in the traverse method. Both methods required a great deal of time and gave only partial results compared to those now obtained by use of a portable dynamic balance machine, designed by General Electric, to eliminate vibration caused by unbalance in rotating masses. The device may be used during initial manufacture or installation of a rotor, after subsequent servicing, or to correct unbalance caused by such action as pitting or corrosion. It may be used while rotors are running in their own or in substitute bearings.

Typical of the increasing use to which the machine is being put are the applications in one section of the country where 40 turbine-generators, varying from 1000-kw. to 62,000-kw., have been balanced.

At one station, a 15,000-kw., 23-stage unit had been realined and balanced by the old method several times, but the results were not completely satisfactory. Using the portable balancing machine, only three runs were necessary to make an almost perfectly balanced unit. Two of these were trial runs, the third was from calculation. The final run called for 0.7 lb. in the collector end and 0.4 lb. in the coupling end of the rotor, both weights being in line for static unbalance. These results led the management to apply the device to seven other units in the station.

In another case, an accident damaged a reduction-gear set on one of the main-drive units of an ocean-going vessel, throwing the turbine out of balance. The portable equipment was used and the unit balanced in three runs.

The balancing equipment consists of three principal parts; a sine-wave alternator, a vibration velocity unit, and an indicating unit and its associated circuits, all fitted in a carrying case (Fig. 2).

In use, the projecting spindle of the hand-held sine-wave alternator is inserted in the lathe-center hole in either end of the rotor shaft (Fig. 1). Synchronous rotation without slippage is assured by engaging a sleeve on the spindle with a tapered pin previously driven into the end of the shaft. The phase angle between the sinusoidal voltage of the alternator and the sinusoidal voltage of the vibration-velocity unit can be varied at will by turning the alternator stator.

The vibration pick-up is placed on or against the bearing pedestal of the rotor. An electromagnetic device, it generates a voltage proportional to the velocity of vibration present in the pedestal. The sine-wave alternator and the vibration pick-up are connected by suitable cables and plugs to the instrument, which remains in the carrying case.

The relative angle of vibration due to unbalance is obtained by rotating the stator of the sine-wave alternator until the instrument deflection is zero, and then

reading the angle on the alternator scale. The magnitude of the vibration is obtained by rotating the alternator stator until the instrument deflection is at the maximum and then reading the mils of vibration displacement indicated on the instrument scale. These two operations are repeated for the near and far ends of the rotor during each of three trial runs.

The rotor is kept at the same speed during all original-run and trial-run measurements. The equipment is not used to balance rotors at speeds less than approximately 600 r.p.m. The upper speed limit to which the equipment may be used with the technique described is about 5000 r.p.m. Balancing above that speed is possible, but additional calibration is required.

The first of the trial runs determines the generating vectors of the vibrations to be eliminated, and the latter two runs determine the susceptibility of the rotor vibration to arbitrary individual weights placed separately in each of the two chosen balancing planes. The twelve readings are then entered on a prepared form sheet, on which each step of the subsequent calculation is outlined (Fig. 3). Part of the form is a polar co-ordinate graph on which the graphical construction part of the solution can be worked out. Complete instructions on the use of the sheets are contained in an instruction book accompanying each set. At first glance these calculations appear complicated, but after several problems have been worked, the solution can be made in a half hour or less. The sheets provide a convenient, permanent record of balancing operations. Reference to such a record eliminates much preliminary work when a machine is rebalanced later.

When desired, a tachometer is used as an accessory with the equipment. The device, illustrated in Fig. 4, measures speed in the ranges 0-3000 r.p.m. and 0-6000

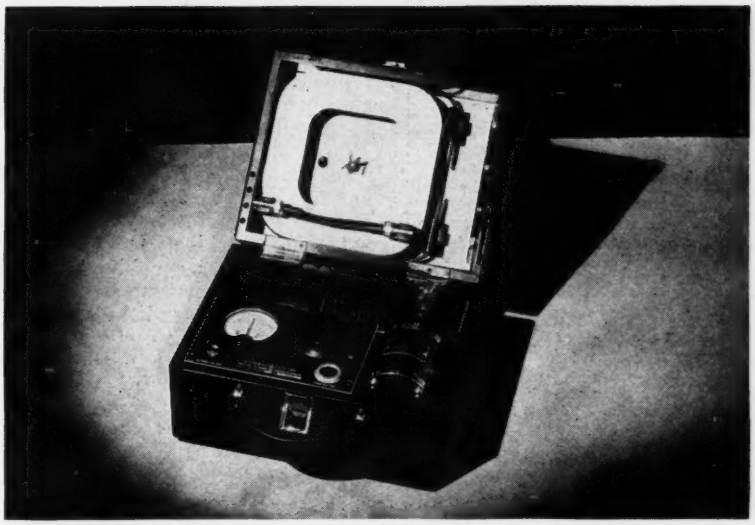
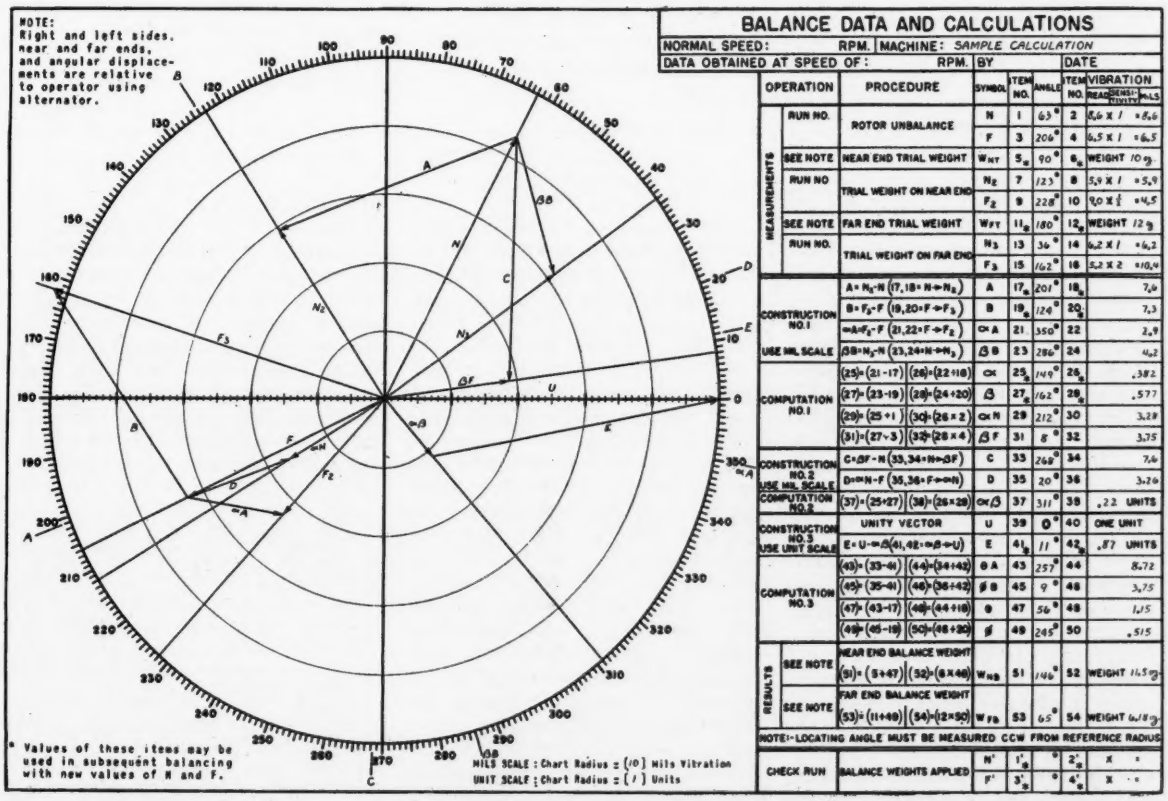


Fig. 2. The portable dynamic balancing equipment in its carrying case


NOTE:
Right and left sides, near and far ends, and angular displacements are relative to operator using alternator.
* Values of these items may be used in subsequent balancing with new values of N and F.
MILS SCALE : Chart Radius ± (10) Mils Vibration
UNIT SCALE : Chart Radius ± (1) Units

BALANCE DATA AND CALCULATIONS

NORMAL SPEED: RPM. MACHINE: SAMPLE CALCULATION

DATA OBTAINED AT SPEED OF: RPM. BY DATE

		OPERATION	PROCEDURE	SYMBOL	ITEM NO.	ANGLE	ITEM NO.	VIBRATION READ	SENSITIVITY	MILS
MEASUREMENTS	RUN NO.		ROTOR UNBALANCE	N	1	63°	2	5.6	X 1	=5.6
				F	3	206°	4	6.5	X 1	=6.5
	SEE NOTE		NEAR END TRIAL WEIGHT	W_{NT}	5_g	90°	6_g	WEIGHT 10 g		
	RUN NO		TRIAL WEIGHT ON NEAR END	N_2	7	123°	8	5.9	X 1	=5.9
				F_2	9	228°	10	9.0	X $\frac{1}{2}$	=4.5
	SEE NOTE		FAR END TRIAL WEIGHT	W_{FT}	11_g	180°	12_g	WEIGHT 12 g		
	RUN NO.		TRIAL WEIGHT ON FAR END	N_3	13	36°	14	6.2	X 1	=6.2
				F_3	15	162°	16	5.2	X 2	=10.4
	CONSTRUCTION NO.1 USE MIL SCALE		A = N_2-N (17,18 = N → N_2)	A	17_g	201°	18_g			7.6
			B = F_2-F (19,20 = F → F_2)	B	19_g	124°	20_g			7.3
			∝ = A_2-F_2 (21,22 = F → F_2)	∝ A	21	350°	22			2.9
			ß = N_3-N (23,24 = N → N_3)	ß B	23	286°	24			4.2
	COMPUTATION NO.1		(25) = (21-17) (26) = (22+18)	∝	25_g	149°	26_g			.382
			(27) = (23-19) (28) = (24+20)	ß	27_g	162°	28_g			.577
			(29) = (25+1) (30) = (26 × 2)	∝ N	29	212°	30			3.28
			(31) = (27+3) (32) = (28 × 4)	ß F	31	8°	32			3.75
	CONSTRUCTION NO.2 USE MIL SCALE		C = ß F - N (33,34 = N → ß F)	C	33	268°	34			7.6
			D = ∝ N - F (35,36 = F → ∝ N)	D	35	20°	36			3.26
	COMPUTATION NO.2		(37) = (25+27) (38) = (26 × 28)	∝ ß	37	311°	39			.22 UNITS
	CONSTRUCTION NO.3 USE UNIT SCALE		UNITY VECTOR	U	39	0°	40			ONE UNIT
			E = U - ∝ ß (41,42 = ∝ ß → U)	E	41_g	11°	42_g			.87 UNITS
	COMPUTATION NO.3		(43) = (33-41) (44) = (34+42)	ß A	43	257°	44			8.72
			(45) = (35-41) (46) = (36+42)	ß B	45	9°	48			3.75
			(47) = (43-17) (48) = (44+18)	ß	47	56°	48			1.15
			(49) = (45-19) (50) = (46+20)	ß	49	245°	50			.515
RESULTS	SEE NOTE		NEAR END BALANCE WEIGHT (51) = (5+47) (52) = (6 X 48)	W_{NB}	51	146°	52	WEIGHT 1.45 g		
	SEE NOTE		FAR END BALANCE WEIGHT (53) = (11+48) (54) = (12+50)	W_{FB}	53	65°	54	WEIGHT 6.18 g		

NOTE:-LOCATING ANGLE MUST BE MEASURED CCW FROM REFERENCE RADIUS

CHECK RUN	BALANCE WEIGHTS APPLIED	N'	$1'_g$	°	$2'_g$	X =			
		F'	$3'_g$	°	$4'_g$	X =			

Fig. 3. Balance Data and calculations for a test run using the dynamic balancing equipment shown in Figs. 1 and 2

Fig. 4. Electric tachometer used with balancing equipment

r.p.m. The tachometer case contains two jacks, one for each speed range. A lead is plugged into either of the jacks, depending on the speed range desired, and the other end is plugged into the jack in the handle of the sine-wave alternator. The alternator, held against the rotating shaft, acts as a tachometer-generator of voltage proportional to the speed of the machine.

Results being obtained indicate an even wider application of the machine. It will be especially helpful in balancing rotors that are too heavy for any available balancing machine. It decreases balancing costs by making it possible to effect accurate balancing under operating conditions in the rotor's own bearings, eliminating expensive shipment to a balancing machine. The quality of results is improved since balancing under operating conditions corrects for changes such as those due to the effect of load. Rebalancing costs are likewise reduced, since once the characteristics of a rotor have been measured, sufficient additional data for complete rebalance may be obtained from a single trial run.

Condenser Tube Tests

Extensive tests were made, with the apparatus described below, to select the best condenser tube alloy for the extremely bad water conditions at Narragansett Station. Details of the tests results were reported by C. W. E. Clark, A. E. White and C. Upthegrove, at the A.S.M.E. 1940 annual meeting

ONE OF THE main difficulties in the maintenance of surface condensers has been corrosion of tubes. The location of many of our large public utilities and industrial power plants is such that the condensing water is contaminated by industrial waste and sewage, resulting in water which is corrosive. In many cases the water contains gases which are liberated in passing through the condenser and which add to the corrosive difficulties.

Liberation of corrosive gases within the condenser tubes owing to the increase in temperature and reduction of pressure is a principal cause of tube deterioration. Various methods have been tried to remove part of these gases before they can act on the cooling surfaces. One simple method consists of suitable pipe connections from the top of the inlet water boxes to the drop leg of the circulating system. The vacuum produced by the drop-leg siphon draws off a mixture of water and such gases as may be free at this point. However, this will not remove the dissolved gases which are occluded owing to the temperature rise and pressure drop within the tube itself.

Much has been written regarding these matters in the past. However, each location or water quality presents a different problem and results in actual service have more often than not been contradictory.

When the question of condensing equipment for the extension for The Narragansett Electric Co. was under discussion, the condenser-tube problem was seen to be of major importance. The condensing water available is particularly bad and heretofore only jet-type condensers have been used, so no experience has been had with tubes. In an attempt to assure the best material for tubes, it was decided to conduct an extensive test on various materials in a way that would as nearly as possible duplicate the conditions actually existing in a working condenser.

Based on such information as was available, Admiralty-metal, aluminum-brass, and cupronickel tubes were selected as the ones most likely to give good service. A miniature cast-iron condenser with Muntz metal tube plates was used, as shown diagrammatically in the drawing, and tubes of each of the three materials just mentioned, as well as a bronze tube, were installed as indicated in Section A-A.

Barriers were placed in the inlet water box as indicated, separating the sections containing the various kinds of tubes so there could be no possibility of water coming in contact with more than one kind of tube. No attempt was made to vent the water spaces. River water was passed through the tubes at a velocity corresponding to that expected in the actual condenser installation and blowdown water from the station 400 lb. blowdown system was admitted to the steam space.

In addition to the condenser test, an impingement test was made. As will be seen from the diagram, river water from the test condenser was passed through a small heater where its temperature was raised to 90-110 deg. F. and then sprayed against the inner surface of split-tube samples. It was recognized that this test did not bear a direct relation to the conditions existing in a condenser, but it was thought that the information obtained might supplement that from the condenser test.

It was also felt advisable to make an impingement test as it was a test which would produce deterioration in the tube metal more rapidly than would be the case from a condenser test. When the work was started, it was believed that the time element for the condenser test would be of the order of but a few months. Therefore, it was essential that as much supplementary information as possible be obtained. As a matter of fact, there proved to be reasonable agreement between the results obtained from the impingement test and the condenser test.

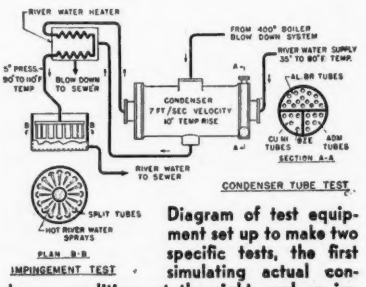


Diagram of test equipment set up to make two specific tests, the first simulating actual condenser conditions at the right, and an impingement test on split tubes at the left

BY

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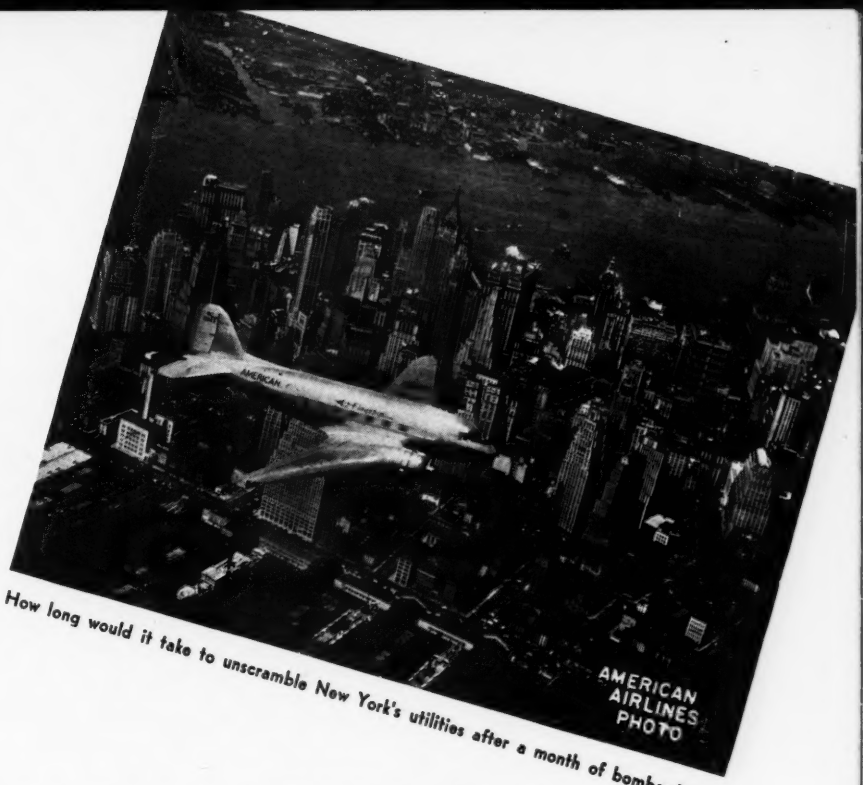


How long would it take to unscramble New York's utilities after a month of bombardment

Wartime TROUBLE SHOOTERS

Not all trouble, even in war, is caused by Stukas and machine guns. The British by brute force destroyed everything before the advancing Germans; trained units of the French army conducted more skillful sabotage; and the Poles—well, after the surrender they, like Ferdinand, just sat and showed scant regard for their "savior's" comfort. Thus quite aside from production, engineers play a vital role in modern war, by maintaining or disrupting a complex industrial organization, during the offense, the defense and in the later readjustment period. In the German army this work, augmenting that of the regular Engineer Corps., is carried on by the recently organized Technical Emergency Divisions. Their activities in Warsaw after the siege and surrender, as well as in the more highly industrialized areas of Flanders, during and after the War in the West, are both an object lesson in adaptable organization and a warning of the need for effective, not superficial demolition

ESPIONAGE and sabotage, common enough in today's newspapers, have a ring of unreality more in keeping with tales of the secret service than with the commonplace life of an engineer. Yet in Europe thousands of commonplace people are using them effectively. Thousands of others—yesterday commonplace engineers in power plants, line crews and industrial plants—are doing their best to minimize and repair this damage. A war behind a war and only time will tell which is the main and which is the side show.

While the need for definite, but versatile, organization of utility and industrial troubleshooters to augment the strictly military Engineer Corps, must have long been apparent, the so-called Technical or Engineering Emergency Units which do this for the German army, are a comparatively recent development. This army group consists of electricians, engineers, mechanics and experts from all branches of industry. The organization, while military in form, is extremely flexible so as to use the versatile, adaptable personnel to best advantage on any technical problem that may arise.

They: provide the advancing troops with electric power and dependable drinking water; cooperate with the combat forces; have available portable Diesel and steam driven generating units; restore the utilities and industrial facilities to service in damaged or occupied areas; co-operate with the intelligence staff in gathering data on occupied areas and in the prevention of sabotage; and do a thousand and one other things as expediency demands. They are the universal trouble shooters of the war who tackle anything and, while the youngest army group, proudly boast that they have yet to fail in carrying through an assignment.

The Polish Prelude

The campaign in Poland provided what a Navy man would term a shakedown cruise. Poland was industrialized only in isolated areas and the limited damage was of a strictly military nature. This provided technical experience and perfection of organization needed to deal with the highly industrialized and interconnected districts of Flanders. There, close in the wake of the army advancing against stiff resistance, with both military damage and organized sabotage to deal with, the task required a high degree of coordination both between their own units and with the combat forces.

Nor was this task either easy or unimportant. In addition to keeping the various utilities in service they restored and put into

production bakeries, abattoirs, flour mills, textile plants, tanneries, chemical factories, paper mills, instrument works, etc. These are listed primarily to indicate the versatility of the organization and the importance of its work. As a side light it is interesting to note that in many cases emergency operation was established first by means of standby equipment so old and neglected that it had been overlooked by those delegated to put the plant out of service.

In Flanders

That sabotage was effective is indicated by the naive complaint of a German engineer about " . . . the egotistic British who without consideration of their allies, destroyed everything that could have been utilized in any way by the advancing German armies . . . "[1]

However, the British, advancing and retreating at practically the same time, had little patience with technique. They depended largely on brute force, rifle butts and sledge hammers in the hands of squads of soldiers. Their work was thorough so that "not even the window glass was spared." The soldiers, however, lacked the technical knowledge necessary to destroy vital parts. Damage was, in many cases, superficial so that in general emergency operation "without the window glass" could be restored in a comparatively short time.

Similar work of the French was more effective and of a different type. It was French property which if lost, they expected to regain. Their object was not to destroy completely but to render all plants inoperative by removing vital parts. This work was entrusted to companion units of the French army, the Sections d'Electriciens de Campagne.

[1]Otto Herdecke in the Elektrotechnische Zeitschrift, Dec. 12, 1940.

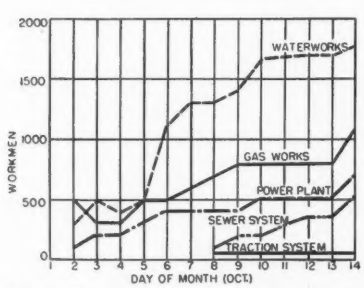


Fig. 1. The number of workers engaged in repairing various Warsaw utilities after the surrender

" . . . At the beginning of the war part of the personnel of the local power plants was replaced by men of these troops. They had orders in case of retreat of the French Armies to systematically remove important parts of machines and control apparatus . . . Entire plants were made inoperative by the removal of parts . . . Often enough the men of the Technical Command recognized the skillful work of experts."[1]

Space does not permit detailed mention of the work they did. Much of the work on this front consisted of repairing electrical transmission line damage. Repairing the cable connections to an air field heavily bombed and later occupied by a fighter squadron. Replacing cables across a destroyed bridge to serve a section of the city occupied by military headquarters. Replacing transformers and switchgear And more ticklish, occasionally removing an unexploded bomb or shell.

Where damage was too extensive, old or spare equipment was used; for instance, an old 880 hp. steam engine and two fire tube boilers in an idle cotton mill, used to supply emergency power to military headquarters and a large prisoners camp.

The "New Order"

Inasmuch as part of this was evidently for charged wire around the camp, the prisoners could hardly be expected to share the enthusiasm of "the Dutch families (who) were glad that the darkness disappeared from their homes so quickly . . . but few were aware . . . the German technicians in the field grey uniforms did their duty efficiently and quickly . . . " Probably the light was appreciated more not knowing this, for the Dutch are an independent people who like to do things for themselves. In their own quiet way they are conducting an effective campaign of non-cooperation as reports of arrests and convictions testify.

Power lines were built or repaired, in many cases so power could be supplied from Germany to occupied territories, in some cases temporarily, in others permanently so as to shut down plants, save coal and utilize to the fullest extent distant hydro plants. In this connection boastfully "such farsighted planning required co-operation beyond political, military and economic boundaries . . . a significant bearing on European electrical econ omy ('new order') . . . these Technical commands are the pioneers of the future consolidation of Europe's power economy."

In Warsaw After the Siege

Probably the outstanding single technical accomplishment of the Technical Divisions was restoration of the power, water, gas, sewage and street car service in Warsaw after the surrender. These divisions advanced with the troops and took charge of all plants and factories as well as of raw and finished materials as they were captured. In this they were hoarders of the booty preceding the final act at Warsaw.

Fighting started around Warsaw Sept. 9, and the city was under severe siege from the 19th to the 27th when negotiations for surrender started. Technical officers entered the city for inspection on the 30th in advance of the troops. They found all utilities at a standstill, gas holders burned out and the plant damaged, the power plant put out of commission by shell fire along with the water works, sewer system and electric transmission and distribution lines.

A city of almost two million people a shambles! No utility service of any kind. More than a third living in cellars and many of these cellars, due to the breakdown of the sewage pumping station and power plant, partially flooded by backed up sewers. This was serious, not only because of possible epidemics, but because a large part of the available food supply was stored in the cellars.

But the Poles proved singularly unco-operative and thoughtless of the comfort of their "saviors." The commander of one of the detachments reports, "The assumption that the Poles would immediately restore these services and that our soldiers would only assist had to be abandoned, otherwise our brave soldiers would have had to be without electric current, water and gas for weeks."[2]

With this in mind the Technical Divisions set to work with a will and Fig. 1 shows the number of men, exclusive of the regular plant personnel, working on the five utility systems from Oct. 2 to 14. Power as the primary service was tackled first. A 400-kw. Diesel emergency set from the sewage disposal plant was util-

[2]P. Munch, V.D.I., Feb. 24, 1940.

(Continued on Page 82)

Keeping Turbine Oil Dry As Transformer Oil

Novel arrangement using compressed air between the water glands and the bearing housings of turbines eliminates all possibility of water contamination of the turbine oil. Those who have been troubled by wet oil will find this simple and effective

BY THE USE of air pressure barriers between the water glands and bearing housings it has been possible in the case of three topping turbines to maintain the oil as dry as that ordinarily maintained in transformers. Before the installation of these air pressure barriers, these turbines were troubled by wet oil. Since this problem of keeping water out of the turbine oil is an important one, the details of these air pressure barriers are of interest. The principle employed is shown in the accompanying illustration.

In short, a small amount of compressed air is supplied to an existing annulus around the shaft, in the so-called "oil baffle", in such quantity that it builds a pressure slightly higher than that on either side of the baffle, thus sealing against flow of water vapor, or oil vapor, in either direction. This same principle has been used in generator design for many years, using generator fan discharge pressure to prevent entrance of oil vapor into the generator induced by the fan suction.

A manometer connected to another point of the annulus under pressure proves the presence of this air pressure barrier and insures continued dryness. A year's experience on one unit, on which serious governor corrosion occurred previously due to wet oil, proves that 30,000 ohm oil (per standard transformer oil test) occurs continuously without trouble. This high degree of dryness is evidenced by unusual clearness of the oil, for at this dryness it is almost as clear as water. Let very little water contaminate it, and it immediately becomes opaque.

When starting the two 1300 lb., 300 lb. topping units so equipped, 300 lb. exhaust pressure, leaking through the ineffective water glands at low speeds, blows into the bearing spaces with several inches of water velocity head. At such time, it is necessary to keep the annulus pressure about double the steam velocity head. When the glands seal, ¼ in. water pressure is adequate.

That water increases sludge formation rate is well known. Its positive absence undoubtedly has a marked effect on oil service life.

No more positive insurance against corrosion of delicate governor parts, tanks, etc., is possible than by positive water avoidance. Corrosion rate is undoubtedly proportional to water present, perhaps increasing more rapidly than linearly. Reducing oil deterioration rate lessens acid formation that accelerates corrosion.

Of course, leaking coolers are not made tight by this plan. However, coolers can be made positively tight, and, the slightest cloudiness of the oil is evidence of a cooler leak if the air barriers are maintained.

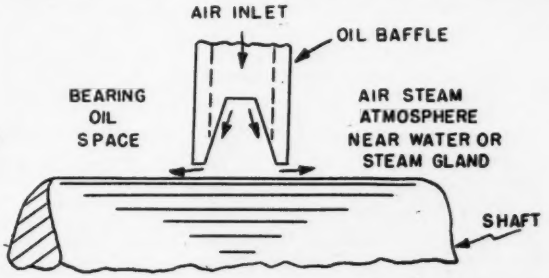
Ten times as rapid drying of oil occurs at 130 deg. oil temperature as at 70 deg. with normal air humidity, providing the air above the oil has the same moisture content as room air. Internal leakage air from the modified oil baffle insures this "room-air" condition above the oil, and in a day or two the previously wet oil reaches the transformer-oil dryness condition. Thus, centrifuging is not necessary to dry the oil initially, for normal drying processes are entirely adequate so long as there is no source of moisture supply.

Some readers may claim that a little condensate is advantageous, for it leeches water-soluble acids from the oil. However, those acids are decomposition products that are formed in greater amounts because of presence of the water. Experience indicates that condensate added to oil on its way to the filter is readily removed by subsidence, whereas any water circulated through the pumps and bearings becomes so finely divided that settling is but slightly effective. With this plan, condensate washing can possibly be practiced exterior to the turbine reservoir without causing noticeable wetness.

Positive Insurance Against Oil-Water Emulsions

A turbine with dry oil emits practically no "oil-vapor" to the turbine room, experience shows. When the oil is wet, a miniature cloud escapes from vents, and "sweat" appears on the under-side of oil tank covers.

In the past, turbines have, on a few occasions, been forced out of service without warning due to emulsions of oil and water. Though present-day oils are unlikely to form emulsions, the continual isolation of condensate from the oil system is positive insurance against them.



Air Barrier to Keep Turbine Oil Dry

Condensing units can benefit from air barriers at No. 1 bearing. Newer turbines are being made with scarcely any room-air exposure around the shaft at this point, which increases the amount of water vapor present for leaking into the oil space.

If adequate size air passages can be provided to the oil baffles, a small fan might be used to maintain the air barrier instead of the more expensive compressed air. However, on topping units, compressed air appears necessary because of the higher pressure requirement, especially after shaft clearances increase after long service.

LOCATE IDLERS To Avoid Reverse Bends

Life of wire rope and V-belts has been greatly lengthened by changing the location of the idler pulley from the outside to the inside of the drive

By F. L. SPANGLER

WHEN IDLER pulleys are applied to flat-belt drives, it is obviously desirable to locate the pulley on the outside of the belt, since otherwise the arc of contact of the belt with the driving and driven pulleys will be reduced.

With wire ropes and V-belts, however, there is good reason to avoid the use of idlers in this position. Nevertheless, the custom of locating the idler pulley on the outside of the drive belt has persisted even in the case of these other types of drives, to the detriment of rope and V-belt life. To obtain long life with rope and V-belt drives, all idlers should be placed to contact the inside surface of the ropes or belts. Where this is impracticable, such as in the wire-rope application shown in Fig. 1, the idler sheave or drum should have a larger diameter than ordinary in order to reduce the destructive effect of fatigue resulting from reverse bending of the ropes or V-belts. Where the idler is close to an adjoining sheave or drum, the effect of reverse bending is particularly severe, and, in the case of wire rope, the life of the rope is reduced as much as 50 to 60 per cent. By making the idler sheave ⅓ to ½ larger in diameter than the adjacent sheave, much of the destructive effect on the rope is eliminated.

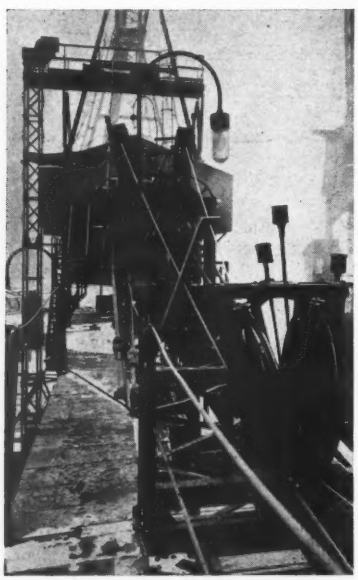


Fig. 1. Large sheave and wide separation between sheaves reduce the damaging effects of reverse bends in these ropes

Where wire-rope reverse bends are encountered, such as on basement-type drum elevators and on the closing lines of grab buckets, preformed rope is often specified because the pre-set wires and strands in this type of rope provide equal distribution of load and easy adjustment to bending, thereby resulting in lower stresses and greater resistance to metallic fatigue which is accentuated by reverse bending.

Eliminating Reverse Bends

By a simple redesign, it is often possible to eliminate reverse bends. The continuous wire-rope drive shown in Fig. 3A has two reverse bends, as a result of the location of the take-up sheave. By redesigning this drive according to Fig. 3B, these reverse bends are eliminated, resulting in greatly increased life of the rope.

Destructive action of reverse bends in wire rope is produced by fatigue, which probably also explains the more rapid deterioration of V-belts that are subjected to reverse bends. Fatigue is caused by alternating stresses in the wires of the rope. When a given point on the rope passes onto a sheave, the rope bends in one direction and high bending stresses are set up in the crown wires of the rope. When this point passes off the sheave, the rope straightens out and these stresses practically drop to zero. If, however, the rope then is bent in the reverse direction, the effect is somewhat the same as bending a wire back and forth, first in one direction and then in the other, causing the wire to break at the point of bend. In other words, the fatigue action is much greater with reverse bending than when all bends are in the same direction. This is a truism demonstrated every day in the practical operation of ropes.

Idlers for V-Belts

Reverse bends can also be very damaging to V-belt drives. Smooth-face idler drums, used to take up the slack in V-belts, are almost universally applied so their surfaces bear against the flat side of the belts, as shown in Fig. 4A, thereby resulting in reverse bends. The destructive effect of reverse bending on V-belts can be illustrated by an experience with the drive on a clam-shell-bucket dredge.

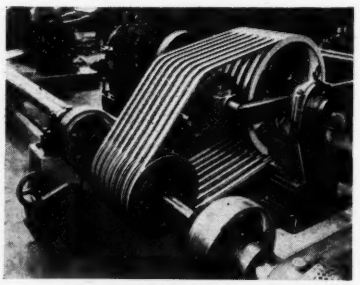


Fig. 2. Vari-pitch Texrope drive on a Fourdrinier in a paper mill with idler on underside of belt. (Photo courtesy of Allis-Chalmers Mfg. Co.)

The operator of the dredge was getting such short service from his V-belt drive that he decided to change the idler drum to the underside of the belts. After making the change, he got some astounding results. This dredge was equipped with a 1000 hp. Diesel engine, driving an electric generator through a set of 36 V-belts. There was a fear

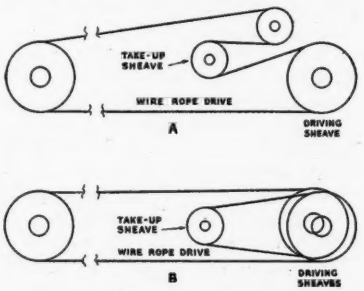


Fig. 3. Continuous wire-rope drive shown in A has been redesigned as in B to eliminate reverse bends

that the application of the smooth-face idler drum on the underside of the belts would result in upsetting of the V-belt section. After 4 yr. of operation with the drum located as shown in Fig. 4B, no upsetting has occurred, and the same belts are still in use that were installed at the time the location of the idler drum was changed.

Earlier with the drum on top of the belts a new set of belts, representing an investment of about $400, had to be installed about every 12 months. Since these belts still appear to be in excellent condition after 4 yr. of service, the dredge operator expects them to last for several more years before being replaced.

Careful consideration of design will in almost all cases reveal some way to eliminate destructive reverse bends. In the case of wire ropes,

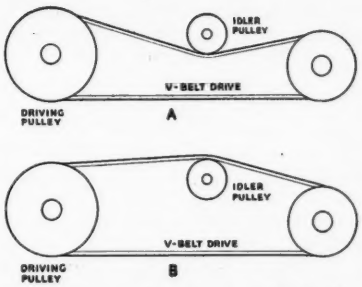


Fig. 4. Diagram A illustrates a V-belt drive from a 1000-hp. Diesel engine. By moving the idler pulley to the underside of the belts, the life of the belts was more than quadrupled

this destructive action can be reduced by using preformed rope and by increasing the size of the sheaves. Even where these corrective measures are taken, however, the elimination of reverse bends will add further to the service life of the rope.

COAL SAMPLING Is Important

When laboratory coal reports indicate your coal dealer is slipping over a fast one—be sure your sampling methods are right before you accuse him of selling one coal and delivering another. Coal preparation is today carefully controlled while coal sampling, to say the least, is largely hit and miss

By J. C. BOOSER

MOST PERSONS buying coal in carload quantities are aware of the significance of the various factors, such as moisture, volatile matter, ash, sulphur content, heating value, and the fusion point of the ash, which form the basis for coal evaluation. Usually specifications are applied to purchases, samples are taken from deliveries and tested, and reports of test carefully scanned to detect any deviation from the specifications in order to accept or reject shipments, levy penalties, or in some cases to determine premium payments if the coal exceeds specified requirements.

Even analyses that appear to be open to question are carefully checked, but usually the original results are verified because coal analytical methods are comparatively simple. In fact errors in the calculations involved, with the analysis are more often the cause for errors in reports than the manner of conducting the actual analysis. However, despite all these precautions many coal analyses are misleading and unfair to either the vendor or the consumer, due to the fact that one of the most critical phases of the entire operation is overlooked, namely, the method used in sampling the delivery.

Good Sampling Ends Trouble

It appears that large and small consumers are subject to this oversight. For instance, a school district buying about four carloads of coal for the heating season was having deliveries tested for a number of years by the laboratory of an industry in the community. The reports of analysis varied considerably from the guaranteed values which, of course, caused repeated disagreements between the shipper and the buyer. Subsequent investigation disclosed that non-representative samples was the sole cause of the difficulty and since that angle has been corrected, coal purchasing has ceased to be a source of annoyance to this consumer.

On the other hand a large consumer, a governmental unit, spending approximately $1,000,000 annually for coal, has taken steps to correct this and other angles of their coal purchasing program. Formerly each using agency of this unit handled practically all phases of their own particular coal purchases, and in no instance that was observed by the writer did the person or persons responsible for the procurement of the coal realize the necessity of following certain procedures in order to obtain representative samples of the coal delivered. Specifications were applied to purchases, and analysis made of shipments, but the reports of test were worthless due to this oversight.

Large Number Lax on Sampling

Numerous other cases similar to these two have been observed and it is estimated that from 25 to 50 per cent of coal consumers who have their deliveries tested make this same mistake. To anyone conversant with laboratory practice it is readily apparent that an analysis of a non-representative sample of any material is worse than useless. Coal is no exception to this fundamental rule, and the fact that it is one of the most difficult materials to sample properly is undoubtedly the reason why so many incorrect samples reach the laboratory. Homogenous materials present few sampling problems, however coal is decidedly not in this category.

It contains from 8 to 40 per cent of inert matter or impurities such as moisture, slate, bone and pyrites, so to get the same proportion of coal and these inerts in the sample as exists in the delivery presents quite a problem. It is obvious that if a small sample of about 5 to 10 lb. is taken to represent a shipment of 500 t., the chance inclusion or exclusion of too much inert matter will greatly affect the sample and render it decidedly non-representative. If 100 lb. were taken instead of 5 or 10 lb. the bad effects of chance se-

lection is lessened. Therefore it becomes apparent that the larger the gross amount, or gross sample as it is termed, that is taken, the more representative the sample is likely to be.

Basis of Correct Sampling

The principle of ratio of particle size to mass of sample, is the basis for the standard method of coal sampling. This method consists essentially of: (a) selecting a gross sample of sufficient size to render chance inclusion or exclusion of impurities a negligible factor; and, (b) by successive operations, reducing particle size by crushing, and the mass of the sample by a simple division called quartering, converting the gross sample to a laboratory sample of about 7 lb. that in turn is representative of the delivery. The mass of the gross sample is governed by the particle size of both coal and impurities, and the amount of inerts in the coal.

Run of mine bituminous containing an average amount of impurities calls for a 1000 lb. gross sample. Slack or small size anthracite in which the impurities do not exist in abnormal quantity, or exceed ¾ in. in particle size, requires only 500 lb. in the gross sample. However, coal containing an unusually large amount of impurities, or if such impurities are very large in size, will call for a gross sample of at least 1500 lb. In all cases a separate 100 lb. sample is also taken and reduced rapidly, to avoid loss of moisture, to 5 lb., and the laboratory uses this sample to determine the moisture content of the coal as received.

Standard Method

This method has been adopted by The American Society for Testing Materials[1] (Designation D 21-40) and The American Standards Association[2] (Designation ASA No. K46-1940). It has also appeared in various technical publications, notably those of the U. S. Bureau of Mines. The detailed procedure can be obtained from these sources. Despite the fact that this method is readily available and generally recognized as being correct practice, its use is either overlooked due to ignorance of its existence, or avoided due to the trouble it entails.

Hand preparation of samples according to this method is admittedly laborious and time-consuming. However, the standard procedure permits mechanical preparation of samples, if such preparation results in equally representative sample. There is at least one mechanical sampler on the market that has proven entirely satisfactory, and it not only simplifies the preparation of the sample, but eliminates the human factor of error to a great extent. Where coal sampling is a matter of routine such equipment is indispensable.

Bad Samples Worse Than None

In cases where the amount of coal purchased is too small to justify the expenditure involved for mechanical samplers, it behooves the buyer to have representative samples taken despite the cumbersome method of hand preparation involved, or, avoid testing entirely and base purchases on the performance of the various coals in use.

The later method of purchasing is not comparable with a system of testing, but it is far better than being misled by meaningless analytical reports due to non-representative samples. The following case emphasizes this opinion and indicates the degree to which poor samples can affect analyses.

Two samples were taken from a shipment of run of mine bituminous coal. One sample was prepared according to the standard method, a 1000 lb. gross sample being gathered. The other sample consisted of 100 lb. of coal carefully selected to preserve the relation of lumps to fines that existed in the shipment, and also to avoid large pieces of impurities. The first sample ran approximately 6.5 per cent ash while the small sample contained 9.5 per cent. The heating value of the small non-representative sample was over 400 B.t.u. less than that of the representative sample.

The coal was acceptable, but had the small sample been relied upon, as happens so often, the coal would undoubtedly have been rejected. The buyer should bear in mind that in some instances the situation may be reversed, and coal that actually runs 3 to 4 per cent over specified ash requirements, with corresponding fictitiously high heating value, will be accepted due to incorrect sampling.

Efforts are being made to evolve coal sampling procedures that will produce representative samples without involving the collection and preparation of large gross samples such as are necessary under the present standard method. A recent development along this line is the new tentative standard of the A. S. T. M.[1] (Designation D 492-40T) on "Sampling Coals Classed According to Ash Content."

Short Methods

Two procedures are described (a) "Commercial", utilizing minimum weight gross samples from 30 to 525 lb. and (b) "Special Purpose", with minimum weight gross samples ranging from 150 to 1750 lb. The commercial procedure has certain limitations and both methods are applicable only to coals having a maximum particle size of 6 in. and under. It would be advisable in dealing with coal sampling problems to consider these tentative procedures along with the standard method.

In summing up the matter, despite progress that has been made in coal preparation, adoption of various classification systems, and other expedients devised to assure the coal consumer of receiving his money's worth, this commodity still remains basically a variable type of material that requires careful checking of deliveries, and so long as this continues to be true it behooves the buyer to look carefully to the proper handling of that decidedly critical phase of evaluating shipments, the sampling procedure.

Electric Output

ELECTRIC energy distribution, as reported by the E.E.I. for the week ending June 7, was 3,040,128,000 kw-hr. This represented an increase of 17.1 per cent over the corresponding week in 1940. The previous week, ending May 31, showed an increase of 18.0 per cent over 1940.

As might be expected, the largest increases, 25.1 and 22.2, occurred respectively in the industrial areas of New England and the central industrial district. The Mid-Atlantic Section and the Southern states were not far behind, but the West Central, the Rocky Mountain and Pacific Coast showed smaller gains: 11.5, 12.3 and 4.2 per cent respectively.

[1]The American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

[2]The American Standards Association, 29 W. 39th St., New York City. The A.S.T.M., D21-40, and ASA, K46-1940, are similar and copies can be obtained from the respective organization headquarters for 25 cents per copy. D492-40T can be obtained from the A.S.T.M. for 25 cents. D21-40 appears on p. 1 and D492-40T on p. 191 of the A.S.T.M. 1940 Supplement, Vol. III which can be found in most industrial and the larger public libraries.

CENTRAL FIBRE
Modernizes at Tama

New boiler and turbine installation opens way to increased production and greater economies in Iowa paper mill

By SAMUEL BLUM
Engineer, H. M. Wilson Co.
Engineers and Constructors
Philadelphia, Pennsylvania

LOCATED at Tama, Ia., the Tama Mill of the Central Fibre Products Co., produced its product at a reasonable cost per ton for power and steam. The plant and equipment were well maintained and housekeeping in general reflected the personal pride of management and men. The one 92 in. engine-driven machine, equipped with Fisher regulating equipment and a Ross vapor absorption system, together with the available rotaries and preparation equipment produced an average of 80 t. of paper board daily. This could with some modification and addition produce 100 t. which in view of the numerous fixed cost items which are divisible by the tonnage produced, the effect on the cost-per-ton of such increased production is quite obvious.

In this plan, however, the steam and power plant was the bottleneck. To increase production, the boilers would have had to be forced beyond advisable ratings, and any additional current requirements purchased. Steam was produced at 160 lb. on three Geary straight tube boilers, rated at 300 hp. and fired by chain grate stokers. All three boilers operated at approximately 150 per cent of rating normally and 165 per cent during winter weather. The equipment being 25 yr. old, any attempt to force greater capacity would have resulted in more frequent shut-down and loss in efficiency.

Current was produced on two engine generators; one a Murray Cross Compound unit, rated at 400-kw., and equipped with condenser; the other an Allis-Chalmers single cylinder machine, rated at 240-kw. and exhausting at 20 to 30 lb. to the paper machine. These engines were excellently maintained and produced about 75 per cent of the power needs; the balance being purchased from the power company.

For obtaining greater steam output, consideration was first given to the possibility of burning oil under the present boilers, but this, though practical and low in first cost, did not prove economical. With oil at the best price then obtainable, the increase in fuel cost was prohibitive. This, when added to the increased cost of purchased power, more than offset the gain which could be realized from the added production. Nor did this arrangement make any provisions for the inevitable lowering of operating pressure which had to be anticipated in view of the age of the boilers, and the more frequent outage which would follow with harder use.

The second, and quite obvious procedure for obtaining increased steam output, was the installation of additional boiler capacity. One new boiler of modern design could readily carry the entire load and operate at an appreciable saving in fuel. This would permit the existing boilers to remain as stand-by; and since they would seldom be used, their life as such could be prolonged indefinitely. The new boiler could be designed for higher pressure and future heat recovery, thus preparing for the installation of a turbo-generator at some later date when the current requirements became still greater or existing reciprocating units had to be discarded.

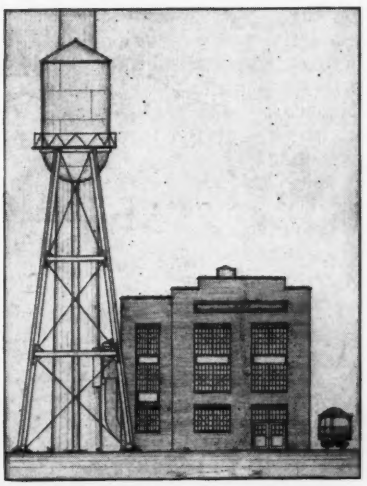


Fig. 1. (Above) Artist's drawing showing the structure as it will appear when completed. Construction is on schedule but a serious delay seemed imminent last fall due to cold weather. The structural frame was completed, as shown in the bottom view, just about the time cold weather broke and threatened to delay the brickwork and with it the entire project. Plant Superintendent George A. Bogle had an effective solution of this problem, however. A quantity of heavy board was made in the plant paper machine and waxed on the calenders. It was then nailed over a wooden frame surrounding the structure and formed a giant cardboard box (center view) in which work was continued without loss of time

A boiler addition as contemplated, however, involved quite an expenditure; and though the improved efficiency would yield an appreciable saving in coal cost, this saving would be more than offset by the carrying charges on the cost of the improvements. In other words, though additional steaming capacity was desirable and new boiler equipment was inevitable, there was prospect of a very limited payoff on the capital expenditure required for this purpose.

Further consideration was therefore directed toward additional savings which might be realized. These could, of course, be found in the purchase of current and possible improvement of the steam balance which was being obtained with the existing reciprocating units. Once the boiler capacity was made available, the proper application of a turbo-generator could be made to produce real returns. In this particular case it was found that by increasing the capital expenditure to include the turbine equipment, the savings which would be possible with a boiler alone were more than trebled.

In view of the favorable performance and condition of the rest of the plant, the Management decided in favor of the complete program and the design was carried out accordingly.

The building for housing the new boiler is an extension to the present boiler house; constructed of steel frame, concrete floors and roof; brick walls and steel sash.

The boiler selected is a Springfield straight tube cross-drum sectional water tube type, with full water walls on sides, front and rear; superheater of the continuous loop convection type located in the upper deck and arranged for self-draining; and a bare tube counter flow economizer.

Water walls and roof are backed with tile and insulation and the entire unit is fully steel encased to insure against any leakage.

The equipment, with feed and steam piping, is designed for 410 lb. 125 deg. F. superheat, but, in order to utilize the existing feed pump equipment, the plant will for the time being operate at 275 lb.—125 deg. F. sh. The unit when producing the maximum plant steam requirements will operate at about 200 per cent of rating, but is designed to carry 250 per cent of rating with ease.

The stoker is of a Coxe traveling grate type, 14 ft. wide, 18 ft. 5 in. long, with an effective area 259 sq. ft. Lower headers of the side walls form a clinker chill for the entire length of the stoker. It is driven by a constant speed motor through a 6 to 1 Reeves variable speed transmission actuated by the combustion control equipment. The equipment was selected to burn Iowa and Illinois bituminous screenings ranging in B.t.u. value from 9600 to 12,000 per lb.; moisture, 16 to 18 per cent; ash, 12 to 16 per cent; and sulphur, over 4 per cent.

At maximum output the burning rate will not exceed 39 lb. per sq. ft. of grate and the furnace volume provides for a maximum heat release not exceeding 42,000 B.t.u. per cu. ft.

This fuel, with its long flame characteristic and high volatile content is unusually difficult to burn smokelessly. The furnace contour was designed particularly with this difficulty in view, and, to further insure smokeless operation, a system of overfire air jets, supplied from a separate blower, is provided at both front and rear arches. T. Z. steam jets are also provided at the front corners so the most satisfactory and economical operation can be obtained at any rating or with any type of coal. A McNeil smoke indicator is provided to give warning if adjustments are not right. Anticipated efficiency at 250 lb. pressure with 10,130 B.t.u. coal is 82, 81.95 and 80.90 per cent respectively at ratings of 45,000, 60,000 and 75,000 lb. per hr.

Forced draft is provided by a Clarage double inlet fan, direct

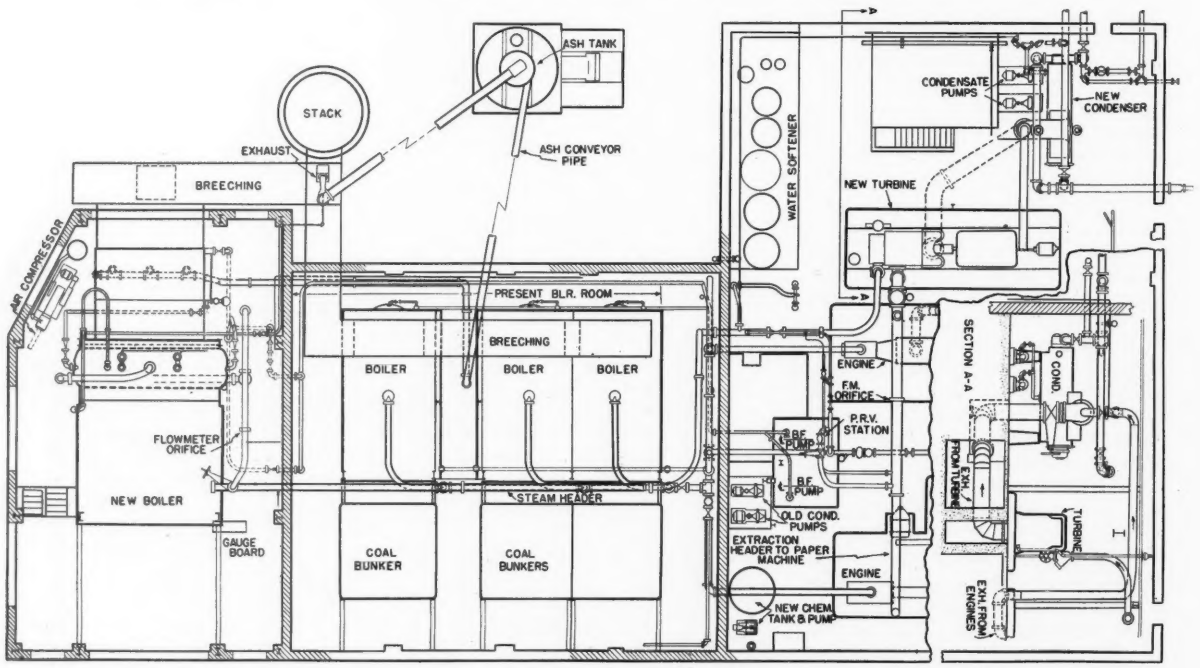


Fig. 2. Plan showing the new boiler room extension, the old boiler room and the modernized engine room. In the lower right hand corner is a sectional elevation showing the arrangement of the surface condenser

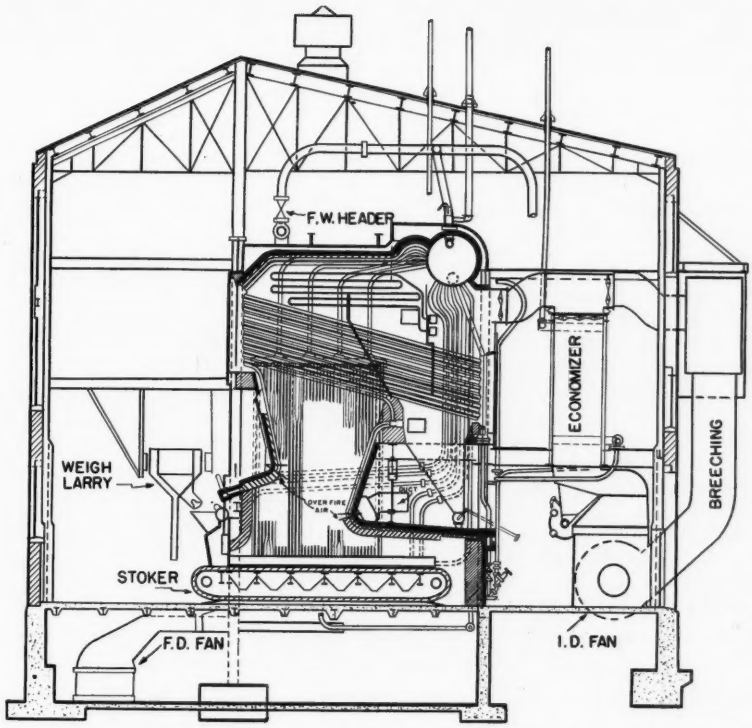


Fig. 3. Cross section of the new boiler. Both overfire air and steam jets are provided to burn a wide variety of Iowa and Illinois coal

connected to a constant speed motor and provided with vortex control actuated from the combustion control system. A separate blower provides air to the overfire jets. Induced draft is provided by a Sturtevant double inlet fan, direct connected to a variable speed motor; the controller being located on the gage board at the front of the boiler. Draft is varied at the boiler uptake damper under control of the furnace draft regulator, the fan speed being changed by the operator. This fan discharges into the existing 7 ft. diam. by 190 ft. high concrete stack. A bypass connection is provided direct from boiler outlet, past the economizer to the breeching, so in case of fan outage, the boiler alone could be operated on stack draft.

Economizer and boiler passes are equipped with Bayer valve-in-head type of soot blowers supplied with steam at about 160 lb. Two retracting gun type blowers under full boiler pressure are provided in the front wall for sweeping the bottom row of tubes arranged to form a slag screen. Siftings in the stoker wind boxes are removed by a specially designed system of steam jets. Water level in the boiler is maintained automatically by means of a Copes feedwater regulator; a constant differential pressure across the regulator being maintained by a Swartwout pump governor controlling the speed of the turbines driving the boiler feed pumps. Feedwater for the existing boilers, when these operate, will be supplied from the same pumps at lower pressure through a Fisher pressure reducing valve.

Combustion control system is of the Republic-Smoot metering type, fully automatic, air operated, with transfer devices on the gage board so each control can be manually operated as desired. It is designed to maintain the following conditions: a, steam pressure at 3 lb. above or below pre-determined pressure setting; b, furnace draft within 0.02 in. of water of the pre-determined setting with load changes up to 20 per cent of maximum boiler capacity per minute; c, CO_2 within 1 per cent plus or minus of the pre-determined setting (12 to 13 per cent), except at widely fluctuating loads; d, smokelessness not to exceed Ringleman's No. 2 Chart at all ratings, allowance being made for separate overfire air which is not under control; e, successfully handle operation between 25,000 and 75,000 lb. per hr.

Complete information and control are centered on a gage board located in front of the boiler. On this board are mounted the pressure gage; recording gage for steam and feedwater pressure, six-pointer draft gage, steam flow meter, CO_2 recorder, six-point potentiometer, smoke indicator, drum controller for induced draft fan, and the combustion control devices. Lights and stop buttons for all motors are also available as well as ammeters for induced draft fan and stoker drives.

A system of walkways and platforms on all sides of the boiler, with easy stairs, provides ready access to all doors and parts, thus encouraging regular inspection and maintenance. The existing coal handling equipment with storage bins in the old boiler house is retained intact. An electrically-operated weigh larry conveys the coal from these bins to the new boiler and provision is made in the new building design to accommodate additional bunker capacity later.

An existing steam jet ash conveyor was converted to an intermittent United type pneumatic system, which handles ashes from both the old and new boilers. A dustless unloader under the ash tank eliminates a dirt nuisance of long standing.

Water supply for the boiler is obtained from a nearby lake. It is first pumped through a revolving screen into a reservoir, after which it is delivered to the mill through the turbine condenser. A branch for boiler feed purposes is passed through pressure filters and Permutit zeolite softeners to an existing Cochrane deaerating heater and storage tank located on a platform well above the pumps and permitting feedwater temperatures up to 225 deg. F. Condensate returns are pumped through a Cochrane pressure oil filter before passing to the deaerator. Supplementary treatment as recommended by Dearborn is added direct to the boiler through a pressure pump.

The new Murray turbine and Crocker-Wheeler generator unit is located in the present engine room. It is rated at 1500-kw. (1875 kv-a. at 0.80 per cent pf.), But the turbine can deliver 2650 hp., sufficient for the full 1875 kv-a. at 1.0 pf. or 1875-kw. The turbine is designed for 450 lb.—750 deg. F. t.t., but will operate at present at 250 lb.—125 deg. F. sh. Steam can be extracted be-

tween limits of 35 to 55 lb. and the exhaust is to a 1300 sq. ft. I-R surface condenser.

That portion of the mill water used for beaters is passed through the condenser as circulating water, the quantity being controlled by means of a regulator actuated by the temperature leaving the condenser. The degree of vacuum is thus governed by the predetermined water temperature; the regulator varying the quantity of water depending on the steam flow to the condenser at any given electrical load. The water balance is maintained by means of an overhead surge tank with float valve make-up. Water passes from the condenser to a closed heater where it is further raised to the desired temperature. The regulator can be bypassed to obtain maximum condenser capacity. Exhaust from the present condensing engine is brought over and connected to the new condenser with valves so either the engine or turbine can be operated on it.

By extracting at 55 lb., steam is made available after producing current; for every process need of the plant including the rotaries which require pressure at 45 lb., and every section of the dryers at pressures varying up to 50 lb. The 55-lb. system is supplemented when necessary by a reducing valve from the 160 lb. mains. To take care of steam to the engines and reciprocating pumps, steam from the boilers is reduced and de-superheated by means of two Fisher-Stabilog operated reducing valves and an Elliott desuperheater. Steam for the boilerfeed pump turbines is delivered at full boiler pressure and temperature.

The new generator is connected to the main bus through an air circuit breaker. Normally this unit will supply all electrical requirements. Outside current however, is being retained for down periods. As stand-by, the existing reciprocating units in conjunction with outside supply can carry on as before. A novel departure on the generator is the location of the air cooler. To avoid the basement, which would be required if the cooler was to be placed in the conventional place below; the cooler is built into a streamlined casing over the generator. A water-tight steel casing construction protects the windings in case of leakage.

This project was designed by, and construction carried through under the supervision of, the H. M. Wilson Co., engineers of Philadelphia, with the helpful co-operation of the plant personnel. In the design every consideration was given to ease and continuity of operation, as well as all facilities for efficient and economic operation.

LIST OF PRINCIPAL EQUIPMENT — CENTRAL FIBRE PRODUCTS CO., TAMA, IA.

Engineers—H. M. Wilson Co., Philadelphia, Pa.

Boiler—Springfield Boiler Co. 1, sectional, all steel water tube boiler (complete with superheater and economizer) 15 sections wide, 8 tubes high, drum 54 in. I.D. Capacity 75,000 lb. per hr. Design pressure 410 lb. per sq. in., initial operation 275 lb., 125 deg. F. superheat. Surfaces: boiler, 8800 sq. ft.; water walls (4 sides) 1880 sq. ft.; superheater (convection type) 1620 sq. ft.; economizer (counterflow) 3000 sq. ft.

Stoker—Combustion Engineering Co., Inc. 1, Coxe Travelling grate, 18 ft. 5 in. long, 14 ft. wide, effective grate area 259 sq. ft. Driven by a 7½ hp.; 1200 r.p.m. motor through a Reeves 6 to 1, Type 3C variable speed transmission.

Ash Hopper—Beaumont-Birch Co.

Weigh Larry—Beaumont-Birch Co. 1, motor driven, floor operated 2000 lb. larry supplied from present bunker and coal elevator.

Ash Handling—United Conveyor Corp. Nuveyor ash tank and rotary dustless unloader.

Feedwater Regulator — Northern Equipment Co. 1, Copes Type R thermostat and Type BI valve.

Steam Jets—T. Z. Railway Equip. Co.

Pump Governor—The Swartwout Co.

Non-Return Valve—The Edward Valve & Mfg. Co.

I. D. Fan—B. F. Sturtevant Co. 1, No. 9 multivane. Capacity 60,000 c.f.m. of flue gas at 420 deg. F. against 5.5 in. static pressure, at 890 r.p.m. Direct connected to a G.E. 75 hp. variable speed motor.

Overfire Air Fan—B. F. Sturtevant Co. 1, Planing Mill 35 in. fan. Capacity 3500 c.f.m. of 100 deg. F. air at 10 in. static pressure. Driven by a G.E. 1750 r.p.m. motor.

F. D. Fan—Clarge Fan Co. 1, Type DWDI with vortex control. Capacity 32,000 c.f.m. of 80 deg. F. air at 4.4 in. static pressure. Direct connected to a G.E. 30 hp. 1160 r.p.m. motor.

Water Treatment—The Permutit Co., Zeo-Dur Softener and filters.

Supp. B. Water Treat. — Dearborn Chemical Co.

Chem. Pump for B. F.—Dearborn Chemical Co.

Soot Blowers—The Bayer Co., 12 units; 2 Model CG gun type; 4 revolving valve-in-head Type VH units on the boiler and 6 on the economizer.

B. O. Control—Consolidated Ashcroft Hancock Co., Inc., Flocontrol.

Combustion Control—Republic Flow Meters Co.

Gage Board—Republic Flow Meters Co. plus the following Republic instruments: two pen pressure recorders; 6 point draft gage; steam flow meters; and recording thermometer.

Stoker Draft Gage—The Hays Corp.

Condensate Meter—Philadelphia Meter Co.

Temperature Recorder — Leeds & Northrup Co. 1, Micromax recorder, 6 pt. on strip chart, 0 to 800 deg. F.

CO_2 Recorder—Leeds & Northrup Co.

Smoke Indicator—T. W. McNeill Eng. Equip. Co.

B. W. Sample Cooler—Cochrane Corp.

Low Water Alarm—Cochrane Corp.

Indicating Gages—Manning, Maxwell & Moore, Inc.

Mercury Col.—Consolidated Ashcroft Hancock Co., Inc.

Aneroid Barometer — Taylor Instrument Cos.

Pressure Reducing Valves — Fisher Governor Co. 2, pilot operated 3 in. Present operation 250 lb., 150 deg. F. sup. to 165 lb. (future 450 lb., 150 deg. F. sup. to 165 lb.)

Desuperheater—Elliott Co. 1, size 8 in., temperature reduction from 556 to 416 deg. F.

Desup. Control—Foxboro Co. 1, 12 in. Stabilog recording temperature controller.

Valves—The Lunkenheimer Co.

Pipe & Fittings—Geo. B. Limbert Co.

Steam Traps—Fisher Governor Co.

Turbine—Murray Iron Works Co. 1, condensing extraction type, 3600 r.p.m. 1500-kw., designed for 250 lb., 125 deg. F. sup. at throttle (future 450 lb., 750 deg. F.), 23 in. vacuum and extraction at 55 lb.

Generator — Crocker-Wheeler Elec. Mfg. Co. 1, rated at 1875 kv-a., 0.8 p.f., 3600 r.p.m., 3-phase, 60 cyl., 480 v. generator with a direct connected exciter.

Throttle & N. R. Valves—Schutte & Koerting Co.

Condenser—Ingersoll-Rand Co. 1, surface condenser with 1300 sq. ft. of surface. Also two horizontally split hotwell pumps.

Switchgear—General Electric Co.

Turbine Monorail—Philadelphia Chain Block & Mfg. Co. 1, 10 t. geared trolley and one 10 t. spur gear hoist.

Expansion Joints—Marquette Coppersmithing Co.

At. Relief Valve—Atwood & Morrill Size 8 in.

Ext. Relief Valve—Cochrane Corp. 1, Special Fig. 1000, 8 in., Multiport back pressure safety relief valve on extraction line.

Con. Water Control—Fulton Sylphon Co. 1, 6 in. Sylphon temperature regulator and valves on condenser circulating water line.

Air Compressor—Gardner-Denver Co. 1, single cylinder, single stage horizontal. Capacity 89 c.f.m. at 400 r.p.m. Pressure 100 lb. Duomatic control. Driven through V-belt by a G.E. 15 hp. 1750 r.p.m. motor.

Vacuum Pump — Wagener Steam Pump Co. 1, size 12 by 16 by 18 in. simplex wet vacuum pump.

Water Supply Pump—Dayton Dowd Co. 1, centrifugal, capacity 1500 g.p.m. against 50 lb. pressure. Direct connected to a G.E. 60 hp., 1750 r.p.m. motor.

Sump Pump—Chicago Pump Co. 2, automatic electric bilge pumps, capacity 50 g.p.m. at 30 ft. head.

Water Eductor—Schutte & Koerting Co.

Resins to Purify Water By Base Exchange

Synthetic resins are employed in a water treating process that yields water with purity comparable to distilled water and suitable for chemicals and foods

WHEN AN ENGINEER reads the history of water purification methods he is impressed with the almost endless variety of materials from the vegetable, animal and mineral kingdoms that have been used at one time or another to remove or modify impurities in water used for specific purposes. Water, being an almost universal solvent, carries with it in its natural state a burden of impurities with which it bargans for the more easily carried materials with which it comes in contact. Through the annals of time, man has developed a technique of trading with water in order to accomplish certain domestic and industrial purposes. For centuries these bargaining methods were conducted along the trial and error procedure. These are now giving way to scientific methods that work with fundamental chemical reactions, and as a result, discoveries are continuously being made of how and why natural waters behave as they do.

Synthetic Resins

Among the most recent water purifying methods is that which employs synthetic resins by means of which it is possible to secure a purity of water equivalent to that secured by the distilling process. In the Industrial Bulletin of Arthur D. Little, Inc., it is stated that the resins for this treatment are of two types, the polyhydric phenol-formaldehyde type used for changing a calcium chloride water impurity, for instance, to hydrochloric acid by replacing the calcium with hydrogen, and the amine-formaldehyde type which removes the acids themselves. As "base-exchange" media substituting one type of water impurity for another of less injurious type, the polyhydric phenolic resins promise improvements over other materials, but the amine-formaldehyde resins, used with the phenolics, offer an entirely new method of complete water purification.

Water "softening," at present, largely involves replacement of soap-destroying and scale-forming calcium and magnesium with relatively innocuous sodium by use of mineral zeolites or sulfonated carbonaceous materials. After becoming "exhausted" by absorbing their quota of calcium and magnesium, these materials can be regenerated by passing a strong sodium chloride solution through them. The sulfonated carbonaceous materials, more recent than the zeolites, offer the additional advantage of replacing the calcium or magnesium with hydrogen instead of sodium, if desired. Thus if calcium bicarbonate is present, carbonic acid can be formed by replacing the calcium with hydrogen. The acid can then be expelled as carbon dioxide by aeration, effectively removing the dissolved salts rather than merely replacing them. This is particularly valuable in water for boilers, where alkaline salts are objectionable because of their tendency to increase the foaming and priming characteristics of the water under some conditions and also because of their possible influence on embrittlement of boiler steel.

The Theory

The action of polyhydric phenol-formaldehyde resins is much the same in principle as that of the sulfonated carbonaceous materials. There is hydrogen available (in the resin's hydroxyl group) which readily goes into solution to replace calcium or sodium ions and forms acids, or, if desired, the resin may be reacted with sodium and will then replace calcium or magnesium impurities with sodium. The general dependability of the phenolic resins is said to be superior to that of previous softening media; they are reportedly physically more stable, operate over a wider range of acid concentration and are significantly faster in action.

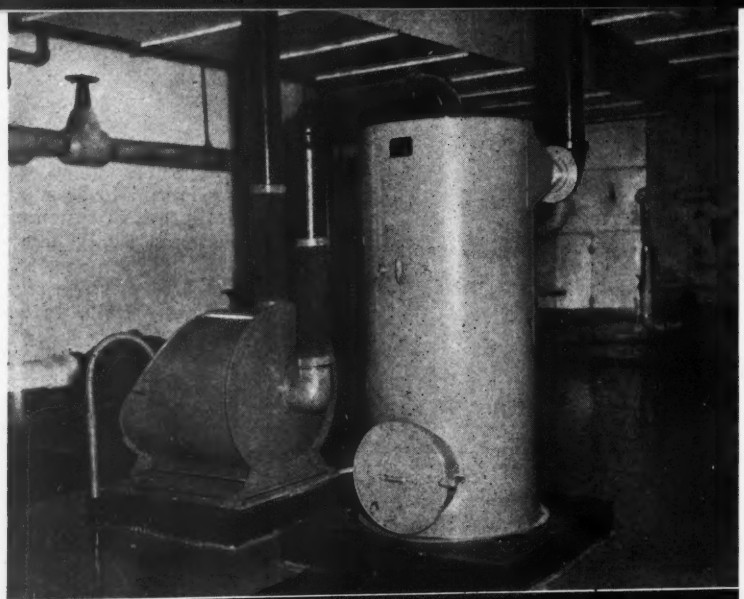
However, save for the fortunate instance where carbonate forms one of the impurities and can be removed as carbon dioxide gas after treatment, none of these methods achieves actual removal of dissolved materials from the water. Complete removal is the function of the amine-formaldehyde resins, acting on the acids previously produced by phenolic-resin treatment. The theory of this removal is not yet entirely clear, but is believed to include both surface adsorption and reaction of the acids with the amine groups of the resin. Thus a water containing calcium chloride, for instance, as an impurity, could have the calcium replaced by hydrogen to form hydrochloric acid by treatment with the phenolic resin and then have the hydrochloric acid removed bodily by the amine resin to yield essentially "distilled" water. Just as the phenolic resins can be regenerated by an acid solution after exhaustion, the amine resins can be regenerated by an alkaline salt solution.

In Food Industries

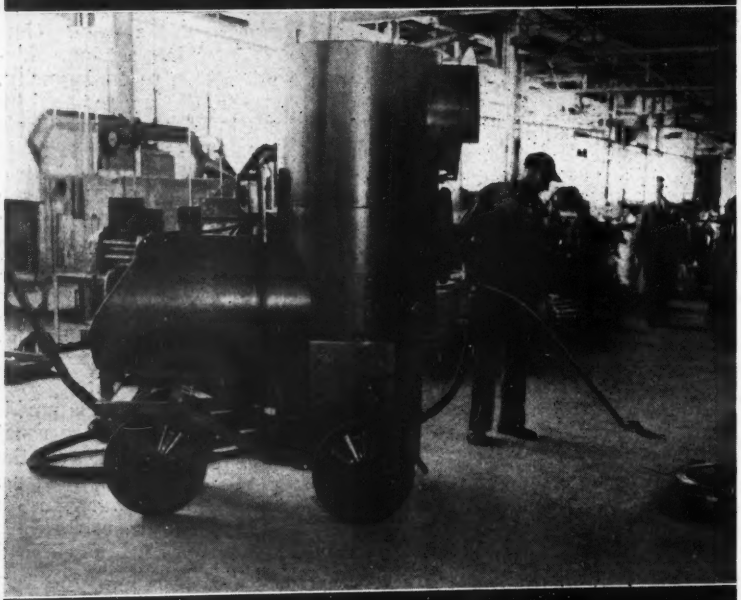
The completeness of this purification lifts it far out of the usual water-softening class and opens the way to numberless applications. For ordinary hard water, resin purification may be more economical than distillation. It is claimed that the water after treatment contains a total solid content approximating that of distilled water. Water of this type is essential for use in high-pressure boilers where water purity is an important factor. Purification of water containing desired organic materials which would be destroyed by distillation forms another class of applications. Some salts, for instance, are injurious to enzymes; resin treatment removes the salts without affecting the enzymes. Water purity is highly important for rectifying spirits; resin treatment here offers a convenient means of avoiding water distillation. Similarly, in other food industries, water purity is a vital factor in taste, and in chemical and pharmaceutical purification the resins are said to be suitable for purging dissolved mineral impurities from aqueous solutions of organic products.

MILADY'S FRIEND

—the vacuum sweeper may be effeminate but there are many he-man members of the family that can do a super job on any plant cleaning problem



A small stationary unit (above) of the type popular with hotels, office buildings and large plants where a vacuum piping system is justified. The exhauster and dirt separator do not necessarily have to be located close together



A large size portable unit (above) with the exhauster and separator built integral. Units of this kind are also convenient for permanent installation in industrial plants. (Below) A small size portable unit in a machine shop

WHILE GOOD housekeeping is in itself adequate reason for installation of vacuum cleaning equipment, there are other reasons equally valid in many industrial applications. One of these is increased production either by reducing the time required for cleaning production machines, by cleaning them in operation, or by eliminating operating conditions that eventually cause failure with resulting lost time for repair.

In addition to these advantages, the recovery of waste materials, such as lint in woolen mills, bearing metal chips in machine shops, pigments in enameling operations and gold dust from dental laboratory sweepings, often pays extra dividends mounting up to hundreds and even thousands of dollars a year.

Nor can the safety angle be neglected. Many industrial dusts are explosive. Dust collecting on piping, beams, walkways and railings is, therefore, a hazard.

Where areas are small and scattered, and low first cost an important consideration, portable units can be used. These range in power inputs of from ¾ to 7½ hp. with convenient means of emptying the dirt collected. Usually they are motor driven and mounted on wheels for convenience. They are, however, made in many types, some mounted on skids, some gasoline engine driven, and some with special separators for the recovery of valuable industrial materials.

In larger industrial plants, power plants, central stations, hotels, office buildings, institutions, etc., stationary units are usually more desirable. These can be made in any desired capacity, the exhauster and separator may be located where most convenient and the two may be close together or separated by any reasonable distance. Where an explosion hazard exists they may be more easily grounded against static electricity sparks with adequate vents and relief valves.

Cleaning (above) out-of-the-way places, walls, ceilings, pipes, etc., is never neglected when vacuum cleaners are around. Portable units take from ¾ to 7½ hp. but larger stationary units are available. In the plant above a 5 hp. stationary unit is used

Cleaning (above) the interior of a large vertical pump motor with a simple straight nozzle of non-conducting material. Vacuum cleaning is ideal for electrical equipment because it is safe and removes carbon and copper particles

Special nozzles are available for special applications. (Above) Cleaning stock room bins with a convenient, effective brush attachment is handy and effective. (Below) Cleaning a greasy wood block floor with a cleaning compound and water

Removing (above) babbitt chips from engine blocks. (Below) Cleaning dust from the tops of boilers. For inaccessible locations there are special long handled tools for convenience. (Photographs from The Spencer Turbine Co.)

MAGNET COILS AND RELATED DATA

Those of us who, at one time or another, have tried their hand at designing and constructing a magnet coil to meet certain requirements know what an uncertain, discouraging and often thankless job it is. Basic data is meager and difficult to find, and such theoretical data as is available is difficult to apply. Quite often the only consequence of the attempt is the fixation of an inferiority complex. It is refreshing, therefore, to have a specialist in coil winding present his views on the subject and to point out that at best coil design consists of a series of successful compromises. Admitting frankly that coil design is by no means an exact science, he considers the subject from the practical standpoint. This is the first of three articles on this subject by Mr. Erikson. A second, on Coil Characteristics, and a third dealing with practical Application Data and Factory Equipment, will appear in subsequent issues

By B. W. ERIKSON
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General Electric Co., Schenectady, N. Y.

THE FOLLOWING has been written in an attempt to deal with the many phases of coil work from a practical point of view and touches but lightly on the problems of theoretical design. The reason for this is that it has been the writer's experience that the technical design considerations have been somewhat overrated in various scientific publications and other current literature without contributing a great deal to the solution of everyday problems confronting the engineer doing actual coil design and coil application work.

With the foregoing in mind, the subject matter divides itself readily into a study of Basic Considerations and Formula, Characteristics, Application Data, and a final chapter describing Factory Equipment. In the first part, only the first of these divisions will be considered; the others will be taken up in subsequent articles.

Basic Considerations and Formula

What is a magnet coil? To many, it is merely a collection of turns of wire, most often of copper wire, and this is the only type considered in this article. However, to a designer a coil has size, shape, appearance, weight, price and many other characteristics.

As to size, this varies all the way from coils for telephonic devices measuring about ¼ in. square to large magnetic brake or other specialty coils as large as 6 ft. in diameter and weighing close to 1 t. The coil's shape again may be either round, square or rectangular and these factors of course help to influence the final product. For example, if the coil is to be round and not overly large, possibly limited to a weight of 10 lb. when finished, it may quite readily be built on a moulded spool or on a fabricated spool made up with a metal sleeve and fibre, textolite or paper end washers. For a coil, not round but rectangular, these constructions would not be the most suitable and in that case the coils would be either paper layer wound and self-supporting or form wound and taped.

All of the above factors are again subject to quantity considerations as it is evident that if only a small quantity is wanted of a coil that is normally paper layer wound on an automatic machine, it would pay to make such a lot either on a fabricated spool or by form winding and taping.

Special Designs

Then again, there are specialty fields that are so well established in quantity production that they serve as types or standards by which other coil designs are compared. For instance, we all know the approximate size, shape, type and cost class in which electric clock coils belong. Equally distinctive of type is the ignition type coil used for automobile or oil burner purposes, and there are, of course, coils for telephonic equipment that are unique in that as a class they are made from acetate materials and not subject to corrosion or moisture failures common to most all other designs. Besides these main types, there are many hundreds of thousands of industrial magnet coils covering all sizes, shapes and constructions, and it is mainly in dealing with these that the designer can be guided by these notes.

To summarize this paragraph on physical factors, there are four

distinctive types of construction properly used.

A. Paper layer wound coils in which one or more layers of insulating paper (or sometimes cellulose acetate) is placed between each layer of wire.

B. Random windings which are normally coils wound on fabricated fibre, paper or textolite spools or on phenolic or acetate moulded spools. Spools used for coils in this class have also in recent years occasionally been die cast aluminum, particularly where ruggedness and exceptionally pleasing appearance are prime requirements.

C. Taped coils are usually first either paper layer wound, random wound or fabricated by the cotton interweave method which consists of random winding on a form and at the same time winding in with the wire, cotton, silk, glass or rayon yarn, which by interlacing, supports the coil structure. After the coil proper is made it is then as the name implies taped, usually either with cotton tape, glass tape or varnished cambric. Glass tape is particularly suitable for this as its tensile strength is great and its abrasion resistance high on coils that have been varnish treated.

D. Open construction heavy wire coils, which cover special applications such as low voltage series coils for overload relay service and contactor blowout coils. These latter coils are often wound of flat copper turned up on edge and are known as edgewise wound. Coils of this kind are by reason of the heavy conductors used self-supporting and seldom require any spool or other insulation.

When wound from bare copper and where subject to contraction by heavy currents, the turns are insulated by separate paper or mica washers or else the whole structure is dipped in some tough insulating varnish and baked. Mica dust suspended in a varnish is excellent for this purpose and extensively used on railway equipment.

Voltage Considerations

Other points of vital interest to the designer in the early stages of the design are the coil's maximum voltage rating and the minimum frequency on which it will be used. Naturally, the higher the voltage rating, the better must be the insulation provided, particularly if the coil is intended for direct current applications as here induced voltages at the time of circuit interruption often reach peaks of 3000 to 5000 v. On the other hand, if the service is alternating current, preliminary calculations should be made to make sure that, at the maximum voltage and minimum frequency rating, the wire necessary does not become excessively fine. A sound economic limit of wire diameter is 0.004 in., as below this the wire cost per pound increases rapidly and also the chances for failure due to mechanical frailty, both in manufacturing and in service, are greatly increased.

Type Windings

Are coils to be shunt wound or series wound? If for series circuits, are they time rated and will they have to withstand severe short circuit conditions? The answer to these question, of course, influences design and for coils exposed to short circuit conditions (as often found in net work protective devices) this consideration predominates in determining the coil structure. In applications of this sort, it has been found necessary to provide copper of such cross-sectional area as to limit the wire temperature rise to possibly no more than 300 deg. C. for a period of 3 cycles, which is the time ordinarily required for a modern high speed breaker to clear the circuit. Under these conditions mechanical stresses imposed on the winding are often such as to badly distort and flatten the wire itself. The only remedy for these conditions is an extremely compact winding preferably imbedded in some self-supporting compound, such as a mixture of portland cement and a bakelite resin.

Are coils to be for continuous or intermittent service? Obviously, the time rating imposed affects the material volume of the design which may vary from a maximum size fixed by the continuous condition down to limitations imposed by resistance of winding, lack of proper clearance, or creepage, or by mechanical difficulties created by the parts becoming too small to be efficiently and economically assembled.

What yearly quantities are expected? With advances recently made in grading and classifying tools in relation to productive life, this question must be correctly answered and correlated to the design to achieve minimum overall cost. Clearly a job to be built but once in a small quantity does not warrant Class A tools and by the same token when a continuous year to year large production is anticipated, no tool can be too good. For coils of these types, the very winding machines are often built for a particular coil job, as for example, the so-called "Keyser" fractional horsepower rotor winding machine and also the automatic equipments used in the manufacture of refrigerator, telephone, and radio coils.

In terms of service, coil designs of the paper layer wound type are most often used on small devices, such as alternating current or direct current relays, clock motors, etc. For the larger devices performing motor staring or regulating duties, the coils are usually made on moulded or metal spools. The very large coils for such applications as magnetic brakes and solenoids (partly due to size and partly due to requirements of ruggedness) are form wound and taped, put on die cast spools or on fabricated or moulded spools.

Type of Service

Under the heading of service comes still another consideration which has gained much in importance in recent years. This is a problem of building corrosion free coils. By this is meant that the coils should be so constructed that the entrance of moisture does not produce electrolysis with its eventual destruction of the positive coil wires on direct current coils nor should the insulating materials contain any water soluble chemical salts which would by themselves be the cause of acid attack on the fine coil wires for either alternating or direct current applications. It has been discovered in the last few years by one of the leading electrical tape manufacturers that practically all common insulating materials, such as cotton tape, varnish cambric, string, binding twine as well as most of the gummed cloths and tapes are all corrosive, even if purchased to chemically strict specifications at a pH value of 7, when subjected to a potential in the presence of moisture. The only known exceptions to this phenomenon are the cellulose acetate materials and mica.

(Continued on page 83)

Metering Pulsating Flow

By WILLIAM MELAS

Cochrane Corp.

Philadelphia, Pa.

REGARDLESS of the type of flow meter used, where there is pulsating flow involved, it is generally impossible to obtain readings which are directly proportional to the rate of flow. Precautions may, however, be taken which will reduce the pulsations so that only small errors in the readings will result. Pulsating flow is generally encountered in systems where reciprocating engines, pumps, and compressors are used. The intermittent action of such units creates pressure and velocity waves in the fluid which invariably increase the flow meter readings, not because of the oscillation of the pen back and forth on the chart, but because of the inability of the instrument to follow accurately each pulsation.

Errors which result from pulsating flow may be explained by the following example: Assume a steam flow meter with a maximum capacity of 10,000 lb. per hr. If the pulsations of flow are such that at one instant the differential pressure is 48 in. of water and the next instant 3 in. of water, the flows are 8000 and 2000 lb. per hr. respectively for the two differentials. The inertia of the fluid in the pressure piping and of the mercury in the instrument prevents the recorder from following the quick changes in differential. The recorder takes a position corresponding to an average differential of 25½ in., corresponding to 5800 lb. per hr. With the flow for half the time at 8000 and then at 2000 lb. per hr., however, the actual average flow would be 5000 lb. per hr., so that the pulsating flow would result in the recorder reading 16 percent high.

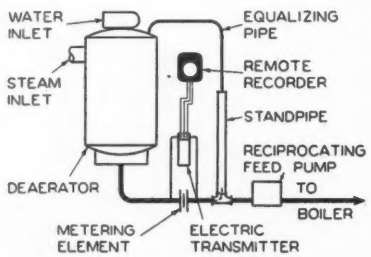


Fig. 1. A patented method of installing a flow meter in the suction between a reciprocating boiler feed pump and an open heater

Inaccuracies due to pulsating flow may be much greater or much less than the amount given in the foregoing example, since the magnitude of the error depends upon the frequency and degree of pulsation, the volume and other characteristics of the piping and the compressibility of the fluid. In any case, it is highly important that pulsations be damped or eliminated in order to measure the flow accurately.

Reciprocating Pumps

By means of the patented method shown in Fig. 1 it is possible to measure accurately water taken by a reciprocating pump from an open feedwater heater or other receptacle having a free water surface. A stand-pipe located between the pump and orifice is vented back to the heater and absorbs the pulsations created by the pump. While the water level in the standpipe rises and falls, due to the pulsations, the flow through the orifice remains fairly constant and allows the meter to respond to a head corresponding to the average flow.

The vent line from the standpipe leads to the space above the free liquid level in the vessel supplied. Where this is impracticable, the standpipe or chamber may be supplied with compressed air. When lack of pressure head or other conditions prohibit the orifice being placed on the suction side of the pump, the arrangement illustrated in Fig. 2 can be used. Here the orifice is located on the discharge side.

Water is directed upward into the chamber, where the pulsations cause the compressed air to contract and expand alternately. The pulsations are thus absorbed in the chamber and allow accurate readings to be obtained with the flow meter. This arrangement is also suitable for use in measuring liquids other than water.

In measuring a compressible fluid such as steam, air or gas, satisfactory results may be attained by installing sufficient receiver capacity and causing the fluid to undergo one or more abrupt velocity changes. This allows the fluid to compress and expand in the receiver space and consequently damps out the pulsations. If a large receiver is not available, "throttling orifices" between the orifice and source of pulsations may be used. These orifices may be economically constructed of thin sheet metal and inserted between flanges in the line. This method results in a pressure loss which is not recoverable, however, and not always desirable.

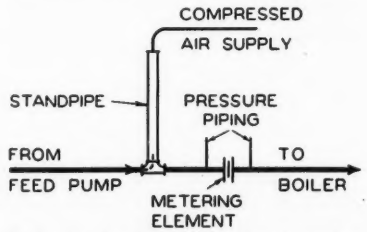


Fig. 2. Air chamber used for dumping pulsations when the orifice is on the discharge side of the pump

ALUMINUM PRODUCTION

AT PRESENT, there is no actual shortage of aluminum for national defense, although civilian applications have been materially curtailed to build up a reserve to help meet the potential shortage of the future. Because of the pressure of defense demands for aluminum, many manufacturers have been forced to develop substitutes. Just how long it will be possible to say there is no shortage is problematical. There may be a shortage next month, in 6 mo., in a year. It depends largely on plane production, not only for the United States but for Britain as well.

According to a recent announcement by W. S. Knudsen, the expanded plane program will require an annual production of 1,600,000,000 lb. of aluminum. The best available estimates indicate that this is more aluminum than the whole world produced last year. The total production of all aluminum in the United States did not exceed 130,000,000 lb. per year in the last world war, and that the

entire industry in the United States did not produce 150,000,000 lb. a year until 1924.

Aluminum production in the United States during 1939 was 327,000,000 lb. Domestic production at present is at the rate of nearly 600,000,000 lb. annually, and by July, 1942, will reach 825,000,000. Until recently, Aluminum Co. of America was the sole producer of primary aluminum in this country, and by July, 1942, it will have completed a national defense expansion program which will more than double the production built up over a half century of operation.

In 1942, the company's production of new metal will amount to more than 720,000,000 lb. To reach this production, and expand fabricating facilities, involves, it is said, some $200,000,000, all of which the company is financing itself.

Forging capacity in the plants of the Aluminum Co. has been increased approximately 175 per cent; extruded shapes capacity, sheet capacity, and tubing capacity have in each case been more than doubled; wire, rod and bar capacity is up 130 per cent, and sand casting capacity is now approximately 200 per cent; more than it was at the start of the war in September, 1939.

On May 29, Dr. Paul J. Raver, Bonneville Administrator, threw an electric switch at the Vancouver, Washington Works of the Aluminum Co., to place in operation the fifth unit of that works. He also called attention to the completion of a large construction project in an unbelievably short time. Less than 15 mo. ago the site now occupied by the new works was a cow pasture. When the switch was thrown the capacity of the plant was increased to more than 150,000,000 lb. annually.

Construction of the new plant began in March a year ago. At that time the plant was designed to deliver 30,000,000 lb. of aluminum a year. The national need became so great, however, that other units were added as construction proceeded. Each unit with an annual capacity of 30,000,000 lb. The first unit went into operation last September, less than 6 mo. after the first concrete was poured. A second unit was completed in December. The third went into service in March, the fourth in April. Bonneville power contracts for the plant cover a total of 162,500 kw.

DOES MODERNIZATION Pay Dividends?

The Premier Rose Gardens say "Yes" and not without reason for an improvement program on two 600 hp. boilers paid for the investment in a year

By Harold D. Brown

BECAUSE of difficulties in maintaining steam pressure with the large load variations in greenhouse heating, and low efficiency caused by the large area of the natural draft chain grates, Paul Bruns, a Chicago florist and a stockholder in The Premier Rose Gardens of Chicago, was chosen to investigate the possibility of finding some means of improving the efficiency of the heating plant. This plant consists of two 600 hp. Kroeschell longitudinal twin drum boilers with water backs in the bridgewalls and one 200 hp. H.r.t. boiler. They supply steam for heating and pumping water for 18 houses, 50 by 400 ft., built separately with a connecting house at the center giving a total floor area of over 360,000 sq. ft.

Each of the 600 hp. boilers is fired with a 11 by 14 ft. Green chain grate stoker, giving a grate area of 154 sq. ft. The grates are driven by a Wachs steam engine, the engine and stack dampers controlled by a Hagan steam pressure regulator. Each of the two boilers has a Hays CO_2 recorder and draft gages, a Taylor flue gas temperature recorder, and a Cochrane steam flow meter.

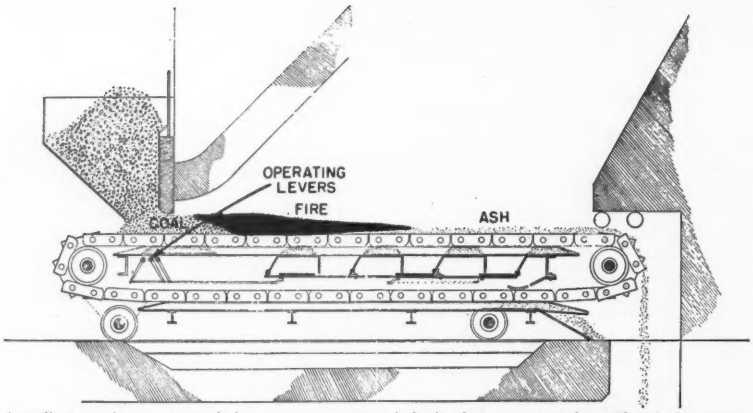
Franklin County ¾ in. dedusted screenings (similar to pea coal in size) are delivered in carload lots on the company's railroad siding. The small uniform size gives a uniform fuel bed which burns out evenly so that the gate on the stoker need only be changed to meet load conditions. The coal is tempered with low pressure steam from pipes in the stoker hoppers.

After investigating zone control on natural draft boilers, it was decided to install Heavey sliding undergrate dampers. These dampers divide the grate area into four zones. The first zone, next to the stoker gate, is not equipped with an undergrate damper because the stack damper controls the air through this zone when the other dampers are closed. The other three zones have dampers under the grate, each arranged so that it can be moved independently of the others. Levers for controlling the dampers are located at the front of the boiler where they are convenient for the fireman.

Installing these dampers cost $2200 plus the labor. In the 1939-1940 heating season, 6700 t. of coal were used to heat the same space that required 7500 t. in the previous year. This in spite of the fact that there were only 5840 degree days in the 1938-1939 heating season as compared to 6600 in the 1939-1940 season, a difference of 760 degree days in favor of the 1938-1939 season. This savings of 800 t. amounted to $2900 at $3.75 a t. Figuring 10 per cent ash in the 800 t., there were also approximately two car loads less of ashes to handle.

At the same time the boiler setting and baffles were gone over and repaired and the meters, flow meters and CO_2 recorders were repaired and checked. These repairs accounted for some of the savings but the major portion was credited to the use of the undergrate dampers. Before installing the dampers, CO_2 on the lighter loads ran from 2 to 6 per cent with about three as the average. After installing the dampers, the CO_2 jumped to from 7 to 10 and 11 per cent with an average of about eight. With the higher CO_2 the stack temperature runs from 50 to 75 deg. lower than before.

Boiler operation has been made easier and there is greater flexibility to meet load demands for the boilers now pick up a load much faster than before. In picking up



Installation of zone control dampers on a natural draft chain grate stoker. The dark portion of the fire represents conditions at about half load, with the two rear zone dampers closed

load when the fire is short, the grate dampers are left closed until the fire covers the zone. Then the damper is opened to allow more air to enter where it is needed. With this method more draft can be used with a short fire without an undue excess air to cool the furnace and boiler.

With the higher draft and short fire, the fire will burn much hotter, making it possible to increase the speed of the stoker without risking the fire running away from the gate or causing a large amount of smoke. Smoke has practically been eliminated, although one boiler still smokes some if operated at over 150 per cent rating. When operating with a short fire, and the load drops too fast to give control by the stack dampers, the undergrate dampers are opened to allow the boiler to cool off and keep the safety valves from popping.

Gas Engine Field Tests

REA STATION of the Louisiana Gas & Elec. Co. at Bunkie, La., the world's largest gas engine central station, was described in detail on page 298 of the May 1939 issue of POWER PLANT ENGINEERING. The original installation of three 1500 hp. Worthington engines driving 1000 kw. generators was augmented in 1940 by an 1800 hp. engine of the same type driving a 1250 kw. generator.

Operating costs for the first year, given in an article on page 72 of the December 1940 issue, totalled 1.842 mills per kw-hr. of net generation based on an average gas cost of 4.99 ct. per M. cu. ft. Since the second article appeared, field tests of both the 1500 and 1800 hp. units have become available and are shown by the attached curves.

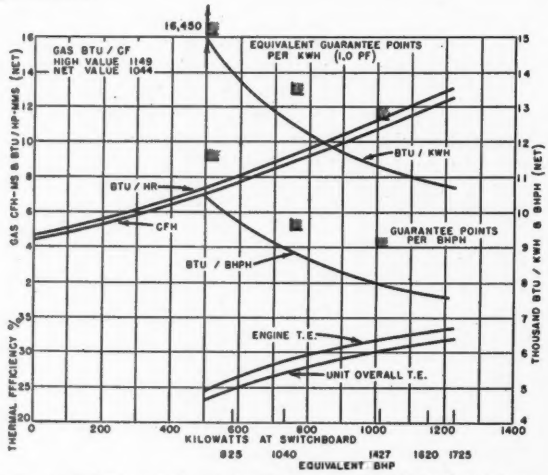


Fig. 1. Field test of the 18 by 25, 12 cyl., 1500 b.hp. Worthington engine driving a 1000 kw. Westinghouse generator

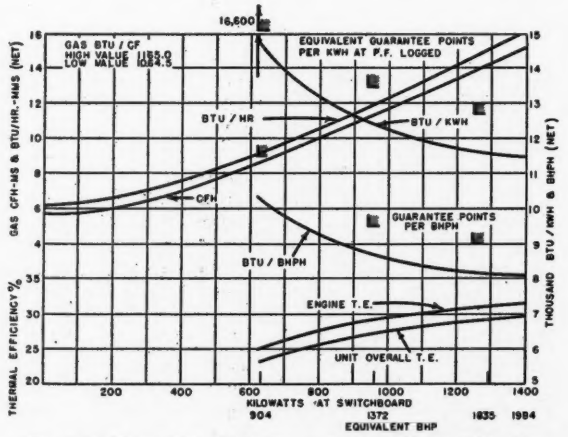


Fig. 2. Field test of the 20 by 25 in., 12 cyl., 1800 b.hp. Worthington engine driving a 1250 kw. General Electric generator

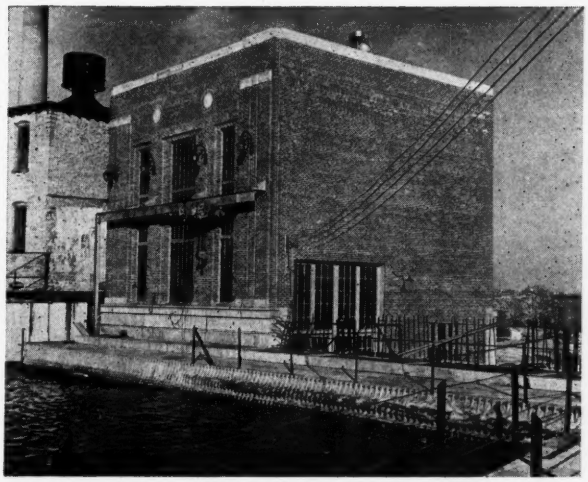
Operating 168 Hours a Week

ROTATING SHIFTS of workers so that equipment is utilized 160, and in some cases 168, hr. a week is practical by means of a system of operation developed by the Timken Roller Bearing Co., Canton, O. Cooperation of employees and S.W.O.C. was secured in planning the system, which is in use at Canton, Columbus, Mt. Vernon and Worcester, O., plants. The daylight shift on Sunday is utilized when repairs or changes in machine setting is necessary.

The method, called by Timken the "anti-black-out schedule," as it avoids week-end stoppage of production, calls for three 8-hr. shifts per day, men working up to 40 hr. a week, with four crews to handle the three shifts. Every man works five 8-hr. days, then is off at least 48 hr., and changes shift.

Over 20 wks., a man works 105 shifts, or five extra days, time and a half being paid for overtime, so that if he works full time he gets five pay days with 10 da. pay each, and 5 with 11 days pay each. He has five Sundays off in a 20-wk. period.

By this plan, equipment is operated at least 150 hr. a week with no relief men required, there is a minimum of overtime, and the same crews always work together. The system has been submitted to Commissioners Knudsen and Hillman to "cooperate with the defense movement" and give "complete utilization of machines necessary during this crisis."



HYDRO-POWER for KAUKAUNA

Wisconsin municipal plant equipped for remote automatic control is operated from another plant a mile away

AT KAUKAUNA, on the Lower Fox River in Wisconsin, the new hydro-electric plant gives this manufacturing city of 7500 population the largest municipally-owned power development in the state. Designed for 5600-kw. capacity, the plant will consist of two units, one with a capacity of 2400-kw. which was installed and placed in operation last February, and the other with a capacity of 3200-kw. will be installed later. The plant was built through the co-operation of the Kaukauna Utilities Commission, the Common Council of the City of Kaukauna, and the Work Projects Administration, the latter agency supplying the labor required for the construction of the dam, the diversion channel, the tailrace and power plant.

Mead, Ward and Hunt Co., consulting engineers, of Madison, Wis., designed the plant, with H. F. Weckwerth, general manager of the Kaukauna electrical and water departments, representing the sponsor.

The Kaukauna plant development included the construction of an ogee section of some 2800 linear ft.; placing the 4000 cu. yd. of concrete; repair of existing forebay walls; the excavation of 70,000 cu. yd. of limestone rock; and the building of the power plant itself.

Originally, the city authorities planned to utilize only 32 per cent of the flow of the Fox River, under a 27 ft. head. This plan was reconsidered and the City of Kaukauna then acquired additional land and water power rights which made possible the construction of a plant which would use 100 per cent of the river's flow under a 22 ft. head. This expanded plan required the construction of a dam to divert the water from the new Badger Hydro-Electric plant on the south side of the municipal development. The completed project cost $550,000.

In order to take advantage of the full flow of the river it was necessary to construct a dam and diversion channel across the entire stream. The portion of the dam excavated is 150 ft. wide and 6 ft. below the crest of the spillway dam. The excavated portion of the diversion channel has an effective area of 900 sq. ft.

The dam has a total length of 2864 ft., exclusive of the north forebay wall. This impoundment is composed of 2328 ft. of gravity type solid concrete spillway, 90 ft. of Taintor gate opening, having a total length of 105 ft. including piers, and 431 ft. of closed dam. One of the Taintor gates is located in the middle channel of the river and the double Taintor gate section is in the north channel, 400 ft. west of the power plant.

There are two trash sluices, one on the north end of the power plant, 4 ft. wide by 4 ft. deep and the other on the south end, 5 ft. wide and 4 ft. in depth. Depths considered are below the crest of the spillway dam. Slots are provided for 4-in. fir stop timbers. The gravity spillway dam has a maximum height of 8 ft. 6 in. above the river bed.

The tailrace is 1200 ft. long and its effective cross sectional area is 720 sq. ft. The width of the tailrace at the power plant is 90 ft. and at a point 400 ft. downstream it starts to widen uniformly until it has a width of more than 500 ft. at the end of the excavation.

The steel framework of the substation was completely built of two old towers owned by the utility company. The tops of the towers were used for the substation towers and cross members of the substation were parts of old vertical members of 60 ft. towers. Space is provided north of the substation for an additional capacity of 4000 kv-a. with the addition of one tower.

The hydro-electric generating unit is started and stopped and both load and voltage controlled from the new Badger plant about one mile away. The self-synchronizing method is used.

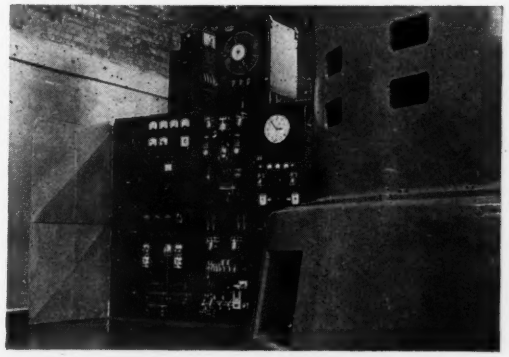


Fig. 1. Interior view of plant showing switchboard beside generator which is operated by remote control

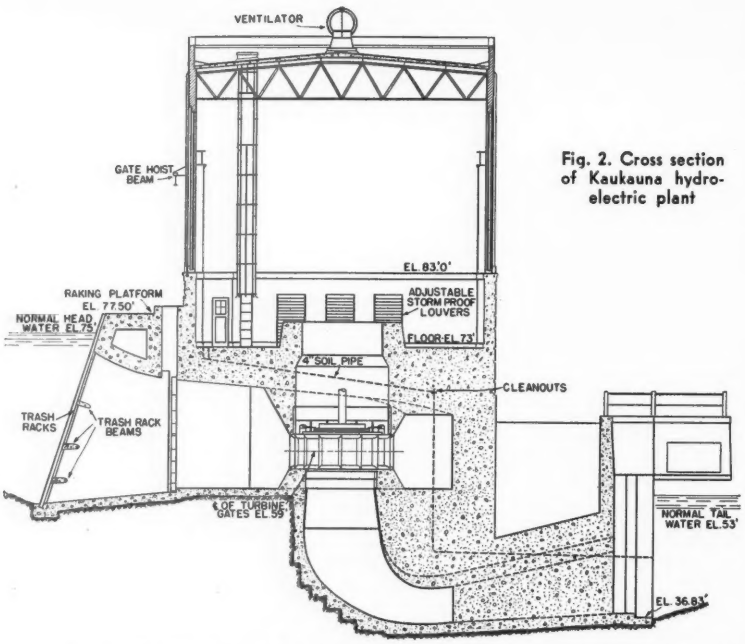


Fig. 2. Cross section of Kaukauna hydro-electric plant

Upon a signal from the new Badger plant, the sequence of starting operations is initiated which opens the water turbine gates to the no-load position for the generator, brings the speed up to about 98 per cent of the rated speed, closes the generator main switch, applies the field required and pulls the machine into step.

After synchronization the load and field excitation are controlled from the new Badger plant.

To shut down the generator, the load is reduced by remote control to no-load after which, following a suitable time delay, the main generator switch opens and the plant shuts down automatically.

The same method of control is available for use by an operator at the new plant. The hydro-electric unit can also be synchronized manually by an operator.

Operation as a Synchronous Condenser

After air valves are opened and other necessary adjustments are made, the generator can be operated as a synchronous condenser under remote control. Starting of the machinery is the same as for generation but after starting, the gates will be closed tightly and voltage excitation control and normal stopping control will be from the new Badger plant.

The new Kaukauna plant is controlled from the new Badger plant by means of a 36-conductor lead covered cable. The conductors are No. 19 A.W.G. tinned, soft annealed copper, solid wire. The cable is suspended from a ⅜-in. messenger wire and 22 conductors are used for the initial unit, 14 conductors are spares for the future 3200-kw. unit.

List of Principal Equipment at the new Kaukauna Hydro-plant

POWER PLANT CRANE — Shaw-Box Crane & Hoist Div., Manning, Maxwell & Moore, 35-ton capacity, electrically-operated lift with 25 hp., 1200 r.p.m., 3-phase motor; lift 42 ft.; span 37 ft. 9 in.; speed 7 f.p.m. loaded.

POWER PLANT GATE HOIST—Euclid Crane & Hoist Co., Type "D" geared trolley hoist, capacity 15,000 lb.; 3½ hp. slip ring motor; 3-phase 60 cycles, 220 v., drum type control, rope operated, variable speed.

GENERATOR—Electric Machinery Mfg. Co., size VX-J, vertical type, 3000 kv-a., 2400 kw., 80 per cent power factor, 3-phase 60 cycles, 2400 v., 722 amp., speed 138.5 r.p.m. Complete with amortisseur windings and oil brakes. Three temperature indicators connected to indicating thermometers are provided in the armature coils. In case of excessive temperatures, electrical controls take the machine out of service and differential relay protection affords further protection to the windings and cable. Guaranteed efficiency at 100 per cent power factor, full load, 96 per cent; ¾ load, 95.9 per cent. Guide bearings—three—upper, middle and lower are all oil lubricated. Temperature indicators are used and connected to indicating thermometers. In case of excessive temperatures, electrical controls take the machine out of service automatically.

EXCITER—Electric Machinery Mfg. Co. direct connected, direct current generator 30-kw., 125 v., 240 amp., compound wound with motor operated field rheostat.

GENERATOR LIGHTNING AND SURGE PROTECTION—General Electric Co., three Thyrite arresters, 2400 v. and capacitor connected directly to the stator leads of the generator and installed in the pit.

TURBINE—S. Morgan Smith Co., Kaplan adjustable blade propeller type. Size 110 in., 3300 hp. at 22 ft. head. Speed, 138.5 r.p.m. Guaranteed best efficiency, 89 per cent. Water consumption at capacity, 1600 cu. ft. per sec. at 22 ft. head. Water is available to operate this unit at full load for 90 per cent of the time.

GOVERNOR—Woodward Governor Co., Type HR, size 13½ by 16, 35,000 ft. lb. A 15 hp., 3-phase, 240 v. motor on a rotary pump maintains an average pressure of 200 lb. The motor is started and stopped by an automatic pressure switch. The servo motor operating the turbine runner blades is located in the turbine shaft. The runner blade control valve establishes a definite relation between the gate opening and runner blade angle for maximum efficiency at all times. Permanent magnet generator—The motor driven governor head is electrically connected to a Woodward permanent magnet generator which is driven by the main shaft of the generator. Full load volts, 75; no load volts, 100; full load current, 2.2 amp.; speed, 138.5 r.p.m.

THRUST BEARING—Kingsbury Machine Wks., Type KBV, 31 in., water lubricated and located at top of generator. A temperature indicator is used and connected to an indicating thermometer. In case of excessive temperatures, electrical controls automatically take the machine out of service. Cooling water required is 3 g.p.m. and is furnished from the city mains. An emergency connection can be used from the river.

AUXILIARY HOUSE TRANSFORMERS — General Electric Co., two 7½ kv-a., one 10 kv-a. 2400 to 240 v., 3-phase and single phase lighting 120/240 v. One 1½ kv-a. General Electric Co. control transformer 2400 to 120/240 v.

OIL CIRCUIT BREAKER—General Electric Co., FK 46, 1200 amp., 15,000 v., 100,000 kv-a. interrupting rating 3-phase, 60 cycles for 2400 v. service on outgoing leads in power plant. Closing solenoid and trip coil operate on 48 v. direct current.

MOTOR GENERATOR SET—The Electric Products Co., diverter pole motor generator. Generator, 0.63-kw., 63 v. d.c., 10 amp., 1750 r.p.m., shunt wound inherent constant voltage. Motor 1½ hp. 240 v., 4 amp., 3-phase, 60 cycles.

STORAGE BATTERIES—Electric Storage Battery Co., Exide chloride type EM-7, 24 cells, 48 v. for automatic controls.

WATER LEVEL RECORDER—The Bristol Co., head water level instrument for transmitting level readings to a recorder in the New Badger plant.

OUTDOOR SUBSTATION—General Electric Co., 3—1000 kv-a. 2400 to 12,100 v., 60 cycle single phase transformers. General Electric Co. station type Thyrite arresters 13,000 v.; 2 sets of pellet arresters, one at substation end and one at power plant end of 2400 v. line. A General Electric gang operated switch is mounted on steel framework for disconnecting the transformers and generators from the distribution feeder.

REFRIGERATING ENGINEER

PART VI

By GEORGE HOLMAN

YOUR FOURTH DAY at the Wholesome plant is much like the first three, only more so. Arriving at the plant that morning carrying under your arm the text book on refrigeration you borrowed from the library, you are confident that you will have some spare time for reading during the course of the day. You lay the book on the window sill as Andy greets you; that is the last you see of it that day.

For the first time since starting to work at the Wholesome you have time to look around and take stock of your surroundings. The place is none too clean. In fact, having prompted the thought, you gravely admit to yourself that the machine room is downright dirty, and the tank room even worse.

You emphatically do not like such filth and after giving the machines a hurried inspection, step out the door and hurry down the street to the next corner and duck into a hardware store. "I want a broom, a mop, a mop bucket and something that I can wipe machinery off with," you tell the clerk, who looks questitoningly your way.

You have just noticed Linda Beechler, another customer in the store. You have dated Linda a few times, and know her quite well.

Linda says, "Good morning, Abel. What in the world are you going to do with a mop and broom?"

"I've started working at the Wholesome," you explain. "I'm getting these to clean the place up with."

Linda lowers her long black lashes, then lifts them flirtatiously. "Once you get broke in on a broom and mop, you should make a very useful husband! I'll just keep that in mind!" Linda giggles delightfully.

"Where have you been keeping yourself lately?" Linda hints invitingly, as the two of you leave the store together. "I haven't seen you since the Glee Club dance."

You recall that you took Linda to the Glee Club dance. As you reach the sidewalk that recollection brings you to think of your first date with June Frost this very evening. And—Good Lord! —who is that but June Frost coming down the street? What if she should see you, and tell Frosty she saw you, a block away from your job?

Linda's car is parked at the curb. You realize, too, that Linda's invitation is about the only way that you can get out of being seen by June Frost. You slide in beside Linda, set the mop bucket between your feet and lower the window so that you can hold the mop and broom by their handles outside.

Everything at the plant is as you left it, but you do not have time to start cleaning up before Butch Fleischer comes in. "It iss a pad pneumonia leak vrom der dermoexpulsion valf in cooler Nummer Zix, Apel, py kolly!" Butch informs you.

Vot a Pneumonia Leak!

You again give the machines a hurried inspection. You go to the tool box, take out some sulphur tapers, a book of test papers and what tools you think you may need and hustle into No. 6 cooler. Things are pretty much as Butch described them, liquid ammonia dripping to the floor and changing first into a wet visible, then into a dry invisible—but certainly not inodorous—vapor.

Leaving the cooler door open to dissipate the gas into the hallway into which all the cooling room doors open, you get a stepladder and climb up to the valve, the only one of its kind in the room. There are two other valves at hand, however, and on the same line. Both are stop valves, one upstream and one downstream from the thermoexpansion valve. There is also a larger cork-covered valve, the return valve on the gas line back to the compressor.

Apparently the gasket between the pipe flange and the flanged end of the valve is not holding against the 200 odd pounds of pressure in the liquid line. With a crescent wrench you try to tighten the two cap screws which holds the two flanges together and exerts the pressure on the gasket. But the cap screws are already pretty tight. Yet if the leak is to be stopped, something must be done. You twist, and the liquid stops spewing. You tear out a slip from your book of test papers, stick the slip into your mouth to wet it with saliva, then try the flanged joint with it. The wetted paper turns a beautiful lavender red. The joint still leaks. You balance yourself on the ladder, adjust the wrench to fit the head of one of the $\frac{7}{16}$ in. cap screws snugly and twist—the head off the screw!

Win by a Nose

You are standing on the top step of the 6-ft. stepladder. With a spray of liquid ammonia swirling all about you, you shut your eyes and jump. The reaction of your jump knocks the ladder over. You beat the ladder to the floor, however, falling on your hands and knees and butting the top of your head against the sharp corner of the door frame.

With blood running from your nose and blood from the scalp wound matting your hair, you race for the machine room. Wondering just how you got out of that cooler, you find a stop valve on the liquid line to the cooling rooms and close it. Now you realize that you should have closed a valve somewhat along this line before trying to tighten the flange.

Butch and his two assistants have opened the hall door and the door into the street. Making a game attempt to reach the ladder lying on the cooling room floor, the fumes drive you back. You remember the gas mask you saw in the toolbox, and dash back to the machine room to get it. While taking out the mask, you look up at the suction gage of the cooling room compressor. It is still 20 lb. Since you cut the liquid off at the stop valve the pressure has not fallen as much as a pound. And the system leaking in No. 6, too!

The glance at the suction gage makes you think of something. Grabbing the mask and running back to the Market to tell Butch

to help, you close as many valves, both liquid and return, as are accessible.

Butch and his assistants decline the invitation and you dash into the lavatory, hold your head under the cold water from the basin faucet for half a minute to wash the blood off, then dash out again. You slip the mask over your face, hook on a canister and try to breathe. Try is all. You back out, jerk off the mask and look at the date scribbled on the canister. It was opened four years ago.

It was good once!

You remember seeing another canister in the tool box. You dash back and get it. Ah, a new one, unopened. You peel the seal, pull the cork and snap the hose over the neck. Again you walk confidently into the hallway, and this time with some degree of success. You almost get to the door of No. 6 before you are compelled to turn back. Outside, you read the directions on the canister. "Good for not more than three per cent of ammonia in air. Above this amount use oxygen-breathing apparatus."

There is no oxygen-breathing apparatus, but because it helps some, you put the mask on again and make a second attempt to get into the hall. This time you jerk open the first cooler door, turn on the lights, jump inside and close the door behind you. You climb upon a pile of boxes and try to close the return valve and liquid valves. With the liquid valves you succeed, but the return valve is so covered with frost that you cannot move it. You give up, and dash along the hall to another cooler. There you find the return valve either held too tight by the stem packing or so set against the backseat that you cannot move it.

By this time the wound on the top of your head has absorbed so much of the caustic ammonia that it burns like fire. You dash back out to the lavatory and again dunk your head under the cold water.

The cold water clears your head for thinking. You remember that the sulphur tapers Frosty lighted to test the ammonia leak around the head of the compressor yesterday made the air smell sweetish and also neutralized the sting of the ammonia to a great extent. You open a whole box of two dozen or so tapers and light the wad of them. Still wearing the mask, you dash into the hall and throw the burning tapers on the floor. Immediately, the hall fills with a dense white smoke which makes the air more breathable, although not a whole lot.

With the intention of cutting off the coils in the chill room, you jerk open another door and rush in. And Glory Be! there it is, already connected to a faucet for washing the blood from the floor after a kill, a full 50 ft. length of garden hose, enough to reach cooler No. 6 easily. You now remember what Frosty said about water and ammonia that day he went into the machine room behind the fire department hose to retrieve Terry Letterbee and Montgomery La Mar.

In a few seconds the hose is off the hook, the faucet turned on and the nozzle adjusted to a fine spray. Behind the spray you advance through the white fog in the hall to a point opposite the door of No. 6 cooler, and into the cooler itself. Liquid ammonia has stopped leaking out and dripping to the floor. But gas still blows feebly from between the flanges. Holding the hose in one hand, you set the ladder upright with the other. You take the hose up the ladder with you, and hold it in one hand while with the other you close the two liquid stop valves upstream and downstream from the thermoexpansion valve and the leak, something you now realize that you should have done before making even the first attempt to tighten the leaking flange joint.

After closing off all the valves possible to close, you go back to the lavatory and dunk your poor aching head in cold water again. With a grim sense of duty you go back into cooler No. 6 and climb the ladder. Even with the valves closed, the ammonia still leaks a little.

You now unbolt both flanges of the thermoexpansion valve. The valve is set so tightly in the liquid line that you must spring the pipe to get it out. By pushing sidewise against the valve and against the elbow where the liquid line turns off into the first pipe of the evaporating coil, the valve suddenly comes out.

The valve is out of the pipe line. But it is not free by any means. What looks like a wire about 6 ft. long runs from the top of the valve to one of the pipes of the coil, where it is firmly anchored in the frost. You move the ladder and climb up to inspect the anchorage. You scrape off the frost and find that the wire runs into the end of a small cylinder an inch or so in diameter and 5 or 6 in. long. The cylinder is held to the pipe not only by frost, but also by two bands of sheet metal encircling both it and the pipe. A small machine screw holds each of the bands together. You unscrew them, and try to pull the bands off. At last they yield.

But the small cylinder doesn't. Either it is frozen solidly to the saddle and the saddle is frozen solidly to the pipe, or they have been soldered or welded in position. After prying awhile with a screw driver, you climb down from the ladder.

With your lungs full of ammonia and the fingers of both hands blue and frostbitten from trying to pry the cylinder loose, you go out into street to get some air, warm up and let the seat of your pants dry out. You go down the street to the doctor's office and have your scalp wound dressed and your nose bandaged.

After awhile you go back and make a second attempt to get the cylinder off the pipe. No dice. Angrily, you go back to the tool box in the machine room and get a pair of side-cutting pliers. You can't see what good that wire does, running from the valve to that cylinder. And you certainly can't fish that headless screw out of the valve flange with the valve hanging in mid air. You've got to have it in a vise. And you can splice the wire back anyway. You climb the ladder, reach for the wire with the side cutters and click—what the heck?

It's Not a Wire!

Something is squirting out. Well, I'll be ——! That's not a wire. It's hollow. It's a tube, capillary tubing. And the cylinder on the pipe. It's hollow, too. And filled with something that is blowing out.

The fog has now cleared out of the hall and, to a certain extent, out of your mind as well. You take the valve to the machine room and search the supply locker for one like it. You can find no extras. You go back to No. 6 cooler for one last whirl at the little cylinder on the pipe. Disgustingly easy, the cylinder now comes off. The cooler has warmed up and it has thawed loose.

Butch comes in again. You look at the valve. "I don't think that I can get this valve fixed this evening, Butch," you say wearily. "And I can't find any extras. I wonder if Frosty could have one of these that will fit this line."

Calling the Aurora, Frosty answers. "I'm in trouble, Frosty," you tell him. "I've had a blow in one of the coolers and need another one of these thermoexpansion valves. Got any extras?"

"I've heard of the blow." You know that Frosty is grinning, although you can't see him. "No, we don't use that type of valve here. You weren't hurt badly, were you? Joe Wiley dropped by to say that he saw you leaving the Doc's office with your head in a sling."

"I'm all right," you insist, although you know that you aren't. "But what am I going to do with No. 6 cooler? Butch has a perishable load in it. And something has got to be done to hold it."

"There are four coils in the chill room," Frosty says. "Three will hold that room until you can do better. Take a thermoexpansion valve from one of the coils there, and put it in No. 6. Take the one from the coil having the least frost collected on it, as that will be the coil doing the least work. If you have a lower temperature to hold in the new location, better open up the valve a little more, say about one turn of the stem for each 3 deg. difference between the average temperature in the chill room and that you wish to hold in No. 6."

No Time for a Pumpout

You make the rounds of the machines with Allen, then go back to the storage to work. This time you know enough to close the stop valves upstream and downstream from the thermoexpansion valve before making any attempt to take the latter valve out of the line. But in isolating the valve, you have also isolated some liquid ammonia between the two stop valves. As you start to open the line at the valve flange, liquid ammonia squirts out.

Just when you are disgusted with everything, in pops Frosty. "Well," he asks, "have you got your cooler back on the line yet?"

"No," you reply wearily. "And I'm not likely to. I started to take this valve out. But there's more ammonia trapped between the stop valves than I can take."

"Close the upstream valve first," Frosty speaks cooly. "Give the liquid 10 or 15 min. to evaporate, then close the downstream valve. That way you will have nothing to contend with but the gas trapped off, and the gas will be at the lower pressure in the coil. That's the only way to handle these valves without a pumpout."

Frosty's presence makes things easier. He stays with you while you take the valve from the chill room and install it in the cooler. He keeps a foot on your ladder while you set the valve in place between the new gaskets you have cut to fit the annular grooves countersunk in the valve flanges. He stays until you have opened the stop valves, the downstream one first, and can hear the liquid ammonia gurgling through the orifice. But when you leave the small cylinder swinging in the air and climb down from the ladder, he asks, "Do you intend to leave the remote bulb hanging there?"

"Remote bulb?" you wonder. "Why does it have to be in a certain place?"

"That bulb is charged with a volatile substance," Frosty explains. "It is always part liquid and part vapor. It is the vapor pressure which opens the valve. As that remote bulb, or feeler bulb, as some call it, gets warm the pressure in the bulb increases. Acting through that small tube, the pressure pushes on a diaphragm in the flat top, called a diaphragm box, of the valve. The diaphragm pushes on pins, which in turn push the needle of the valve away from its seat, and lets the liquid through. When the coils get cold, a part of the gas within the bulb condenses and the pressure on the diaphragm falls. A spring which constantly opposes the diaphragm then pushes the needle against the seat, cutting off the liquid supply to the coils."

"Now do you see where placing the bulb comes in?" Frosty asks. "If you leave the bulb hang where it is, it can get no colder than the air of the cooler. The pressure will continue to hold the needle away from its seat, and the liquid will keep on flowing into the coils even after they are filled. The excess liquid will flood back to the accumulator and fill it. Eventually, the liquid will be carried back into the compressor and cause the safety heads to pound, and possibly wreck the machine. But if you clamp the bulb on the pipe, the cold refrigerant within the pipe will cool the volatile substance in the bulb, ease off the pressure and allow the spring to close the needle and cut off the liquid supply."

It is 3 hr. after your quitting time when you leave the plant. At home you eat a hearty supper, but find thereafter that you are too weary and worn to take June Frost out on that date tonight.

But if you can't fill your date, you owe June Frost an explanation. You go to the telephone and call her. "Listen, Honey, can't we put off our date until tomorrow night?" You plead. "I—I just can't make it. I had an accident today."

Nuts to Refrigeration

"I witnessed your accident!" June's voice is as caustic and as cold as liquid ammonia at atmospheric pressure. "Her name is Linda Beechler!"

Click! June cuts off at her end of the wire. You slowly replace the telephone in the saddle and wait for frost to begin to form on the earpiece.

Wearily you drag your battered, burnt and frost-bitten carcass out of the hot and sultry house to the coolness of the lawn. You pile down on the comparative coolness of the grass beside the rosebush and bemoan your fate. What malignant imp of Satan put refrigeration into your head? And June Frost. Will she be mad at you for keeps? Well, that will be that. Tomorrow you will ask Frosty for your time.

You are half unconscious when you notice a roadster glide up and stop at the walk. As you raise yourself on one elbow you see a slim figure get out of the car and race across the lawn toward you. You try to get up, but fall back instead. You raise your head again. Unless you are dreaming, the figure is the shapely one of June Frost.

"Oh, I'm so sorry, Abel!" June cries. "I didn't know that you were really and truly hurt until Daddy came home and told me. Oh, your poor head!" she adds, sitting down and taking your bandaged head in her lap. "Does it trouble you much, you poor darling?"

Right then it isn't your head that is troubling you, but your heart. And who said that you didn't want to be a refrigerating engineer!

(To be continued)

ELECTRIC UTILITIES READY FOR DEFENSE LOADS

BY ANDREW W. KRAMER
Electrical Editor

Reports of Utility leaders and executives at the Edison Electric Institute Convention indicate that the new generating capacity which is being installed and which is contemplated will be ample to carry the expected increased loads. According to President Kellogg, the new capacity being added this year and in 1942 will amount to over 7,500,000-kw. Aside from the actual additions to the installed generating capacity, many plans and ideas were presented to make more effective use of the existing transmission and distribution systems

THE NINTH ANNUAL Convention of the Edison Electric Institute was held in Buffalo, N. Y., June 2 to 5. Whether it was because most of the utility men were too busy building new power plants to meet defense loads or because the meeting was away from Atlantic City or whether it was only because of the uncertainty of immediate future developments, the fact remains that the attendance and the enthusiasm at this convention was noticeably below that of previous years. There was much friendly mingling among the members present, much renewal of acquaintanceship outside of the sessions and a great deal of hilarity at the G. E. luncheon and Westinghouse cocktail party, but the business sessions lacked the spontaneous enthusiasm that should characterize a gathering of a group of men all engaged in one great activity. The papers and the addresses at the technical sessions were unusually interesting and informative, yet for the most part, they failed to elicit the response that they deserved. All of them were timely and valuable and all of them were presented by men of outstanding importance in the utility industry or related fields.

Naturally there was much stress at this meeting on the need for concerted action on the part of the utility industry in regard to National Defense.

There has been much ill-advised comment in the newspapers lately about the imminent danger of power shortage, of possible lightless nights and other fear provoking ideas. Nearly all of these assertions, it is quite obvious to anybody knowing something about the power business, are unjustified and are made by men who, if they are sincere, are certainly ill-informed. There may be certain isolated instances where because of the sudden development of great electricity-consuming industries, some local power shortage may develop, but such isolated cases do not warrant broad generalization.

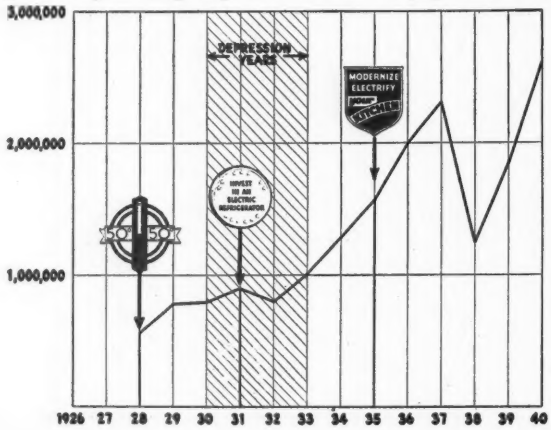


Fig. 1. One of the charts presented by C. E. Greenwood to show the effect of various sales campaigns on the sale of electric appliances. This chart shows sales of household electric refrigerators

The Electrical Utility Industry is fully cognizant of the importance of power in industrial production and is fully conscious of its responsibility to the nation in this respect. During the past 2 yr., since the war emergency has been developing it has not been idle.

As President Kellogg pointed out in his opening address, the utilities as a group have 2,103,000-kw. of new generating capacity scheduled for completion this year, 2,459,000-kw. for 1942 and already 827,000 and 180,000 respectively for 1943 and 1944.

Adding to these figures the capacities projected by the Federal Government, District Authorities and municipalities, together with those of industrial companies, bring the totals of new generating capacity to

1941....4,150,000-kw.
1942....3,430,000-kw.
1943....1,046,000-kw.
1944.... 668,000-kw.

The totals for 1941 and 1942, amounting to over 7,500,000-kw. are on account of the time required for construction, fairly

complete, but the 1943 figures, Mr. Kellogg said, will continue to mount.

The large totals of new power in 1941 and 1942, each exceeding by 50 per cent any past annual growth in demand and each being over 5 times as great as the annual growth during the first World War, Mr. Kellogg said were gratifying, but should not lead us to a feeling of smug satisfaction. Mr. Kellogg pointed to the fact that he had avoided any formal statement on the adequacy of power supply because the answer is so difficult to prove and because the situation has changed so continually.

For the greater part of the past year President Kellogg has been serving in Washington as a member of the O. P. M. As he pointed out, though not actually a part of the Priorities Division, questions of priority affecting electric plants have been referred to him so that in recent months much of his time has been taken up with priorities. Recently, however, a special subcommittee consisting of F. A. Schaff, President of the Superheater Corporation, and John C. Parkes, of the Consolidated Edison Co. of N. Y., has been set up in the Tools and Equipment Section of the Priorities Division to handle utility details—a move of great importance and value to the utility companies.

On account of the importance of the subject, Mr. Kellogg said, that he had advised all of the member companies whose priority claims had passed through his hands that they must demonstrate their need for preference rating by the most rigid proof, giving defense power requirements by detail schedule, with names, amounts of power and the purpose for which used.

Of significance, in view of the criticisms to which the large government power projects have been subjected in the past were Mr. Kellogg's remarks concerning the non-mechanical electrical requirements—those needed for electrometallurgical and electrochemical industries. The case of aluminum was noteworthy, because the demands for power for the aluminum industry are being attended to largely by government plants. Indeed, of the huge aluminum load, which will be well over a million kw. only about 50,000-kw. is expected to be supplied by privately owned utilities. The plants on the Columbia River, whose output seemed a year ago to be almost unmarketable, Mr. Kellogg pointed out, are now being put to use in the present defense emergency.

It is impossible in a brief report to touch upon all the different elements of President Kellogg's address, but his remarks on the relations of the Institute with S. E. C. were of interest. Last winter, he explained, the Institute was requested by the S. E. C. to file an annual report of earnings and expense and to advise the Commission as to the nature of its activities. The request was based on the claim that the Institute was, under the definitions in the Holding Co. Act, engaged principally in the business of furnishing service to utility companies and was, therefore, a service company. The E. E. I. counsel confirmed this finding and the report was filed with the Commission in March. Some members of the Institute, not subject to regulation by the S. E. C. became apprehensive that, as a result of this ruling and filing, they would, solely through their membership in the Institute become subject to S. E. C. regulation and a few members, including the largest, resigned from the Institute.

The matter was taken up with the Commission and after due discussion a letter from the head of the S. E. C. Public Utility Division was sent to members of the Institute. In substance the letter agreed with the opinion of the Institute counsel, that membership in the Institute would not affect the status of any member as to the regulation by the S. E. C., but that if any attempt were made to assert such regulatory power on the basis of such membership, the situation could, after such determination, be completely cleared by resignation.

It was Mr. Kellogg's opinion that this development need not in any way adversely affect the Institute. Since the Institute does collect dues from its member companies, which represent part of their operating expenses, he felt that it was entirely fitting and proper that a public body should check up to see that the services the members receive from the Institute are worth what they cost.

The dues were reduced this year from 1/25 down to 1/35 of 1 per cent of the gross earnings and these dues, the president pointed out, could be still further reduced if more nearly 100 per cent of the industry were members. Even before the recent resignations the Institute membership represented only about 2/3 of the gross earnings of the industry.

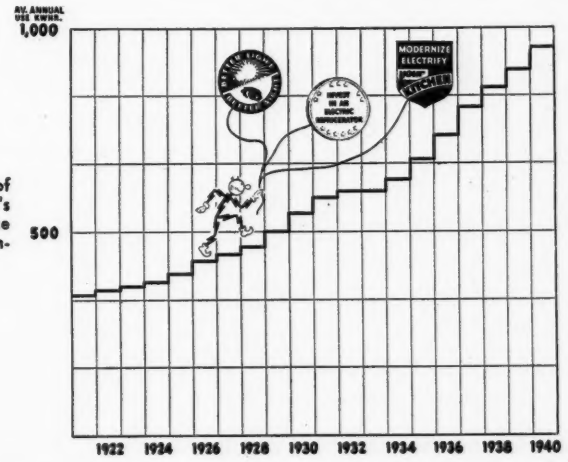


Fig. 2. Another of Mr. Greenwood's charts showing the increase in residential service

Three Classes of Papers

In general, the papers presented at the convention were of three classes: first, those dealing with the electrical industry from the national defense standpoint; second, those relating to the economics of design, construction and operation of plant; and third, those concerned with public relations and sales effort. In addition, there were several addresses on the general war situation. One of the latter was by Constantine Brown of the Washington Evening Star. This clear, comprehensive, if somewhat terrifying, picture of the American situation

with respect to the World War was received with the most intense interest. Having spent 19 yr. in the various countries of Europe as a newspaper correspondent, he possesses an unusual background against which to project the significance of recent events. Brilliantly presented, Mr. Brown's analysis was at the same time depressing.

W. L. Batt, of the S. K. F. Industries, but who is now Deputy Director of the O. P. M., on Wednesday morning delivered an informal address on our progress in the defense program. His address, though it lacked the wide scope of Mr. Brown's address the afternoon before, was nevertheless significant and thought provoking. He recounted some of the difficulties which faces industry in its attempt to gear itself to a 45 billion dollar production program. In a brief but most interesting address he brought home the enormity of the job America is trying to accomplish. Few of us, he pointed out, have any idea of how much material is needed in fighting a modern war.

Our machine gun producing capacity, he said, had been almost nothing. The Colt arms plant, he ventured, probably did well if they turned out, say 500 machine guns a year. Since a year ago, however, Mr. Batt said, production facilities at this one plant had been increased until now they were ready to produce some 5000 machine guns a *month* and this is only a beginning.

More interesting than even these figures, Mr. Batt said, were those dealing with the ammunition for these and other guns. A single machine gun, if it could fire continuously for an hour, which, of course, it cannot because of the heat developed, would in that hour need $5000 worth of ammunition. Similarly, a single anti-aircraft battery of 4 guns, if it could fire continuously for one hour, would in that hour consume $131,000 worth of ammunition! And, remember, said Mr. Batt, this is only for one battery; imagine hundreds of these around our large cities.

It seemed somewhat inconsistent, at a time like this when every effort is being directed toward meeting the rapidly growing power demands to find a number of papers on methods for extending and creating markets. There were three papers in this class; one, Responsibility of Sales Effort in These Changing and Critical Times, by R. E. Fisher of the P. G. & E. Co., another on Plus Sales Values, by Tom Walker of the Gulf States Utilities, and a third entitled Mobilizing Public Opinion on Electric Service Values, by C. E. Greenwood. Mr. Greenwood's paper was historical in nature and in it he showed how various campaigns such as the "Better Light, Better Sight" movements had been very successful in stimulating sales. Similarly the efforts made to educate the public in regard to the value of electric refrigerators and electric ranges, in each case had resulted in noticeable growth of sales. Mr. Greenwood's argument, of course, was for continued effort in this direction on the part of the utility industry so that the basis for sound load growth will exist when the "Post-War" period comes.

Meeting Defense Needs

Of greater particular interest at this time than the group of papers just mentioned were those concerned with the National Defense Program. The question of adequate power for defense needs has been subject to much comment in the newspapers recently, and, while as implied before in this report, it is possible that in certain small areas some lack of power may develop, it seemed quite evident from data cited by Mr. Kellogg and others at the convention that for the country as a whole there was still ample generating capacity to supply even our increasing needs for some time to come.

T. G. Hieronymus, Superintendent of the Underground System Dept. of the Kansas City Power and Light Co., presented a paper entitled Emergency Capabilities of Distribution Plant which was encouraging in its implication as to what modern power systems could do in emergency conditions. In cable operations, for example, he pointed out, that instead of striving for a useful life of from 25 to 30 yr. as at present, it might be economical to so load those cables that the life would be 5 or 7 yr. In the case of making temporary repairs interesting expedients are possible. Manhole explosions often wreck as much as 35 ft. of manhole and conduit line and it takes a great deal of time to restore service in the normal manner. A number of companies are now stocking reels of cable twice as long as they normally would be required in order to bridge around a manhole that might be so damaged. Such cables could be installed in a wooden conduit line to protect them from traffic.

Stimulating and important was the address of William P. Witherow, President of Blaw-Knox Co. and Chairman of the Defense Committee of the National Association of Manufacturers. Being closely associated with developments in Washington, Mr. Witherow was able to present a very forceful and comprehensive picture of how American manufacturers are co-operating in the National Defense Program. He also emphasized the fact that for the country as a whole the power supply as augmented by new construction scheduled for completion in 1941, 1942 and 1943 should prove ample for all demands upon it. In a few areas, he pointed out, there was danger of some shortage, but these situations were being corrected.

There was need, Mr. Witherow pointed out, for further progress in the interconnection of systems and the closing of the four principal gaps in the high voltage transmission system. To those who are impatient with the progress that is being made in the defense program, Mr. Witherow's recapitulation of what industry has done so far was encouraging. Industry, he said, has furnished the government with production and business experience needed to administer and oversee the production of the great military machine. Industry has re-forged its plowshares into swords, its pruning hooks into spears. A maker of sewing machines now makes pistols. A maker of lingerie weaves mosquito netting. A linoleum factory makes shells. Oil plants make rubber and rubber factories make gas masks. A typewriter factory turns out machine guns. A tobacco machinery plant manufactures Diesel engines. A lipstick maker produces shell cases. And so on, the list is all but endless.

Col. H. S. Bennion, managing director of the Institute, presented an informative paper describing what has been happening in load and capacity by means of a series of charts. But, as he pointed out, these charts are useful merely in giving a general picture of the sit-

uation. It is not possible by statistics to give a true measure of the engineering and operating factors pertaining to the load and ability to supply it in any particular territory or group of territories.

Looking Ahead at a 110 Billion Dollar Peacetime Economy

A very interesting and unusual contribution to the proceedings of the convention was D. C. Prince's address on the partnership between manufacturers and the power industry. Mr. Prince, who is manager of the Commercial Engineering Department of the General Electric Co., presented a most interesting group of charts relating to national income and the effect of defense upon the national income. Looking far ahead, at a national income of 110 billion dollars in 1946, he considered how this huge national income brought about by war effort could be maintained after hostilities ceased. This was a problem for both government and business and he suggested that we start to plan now so that we will be ready to make the transition from war to peace when the proper time arrives.

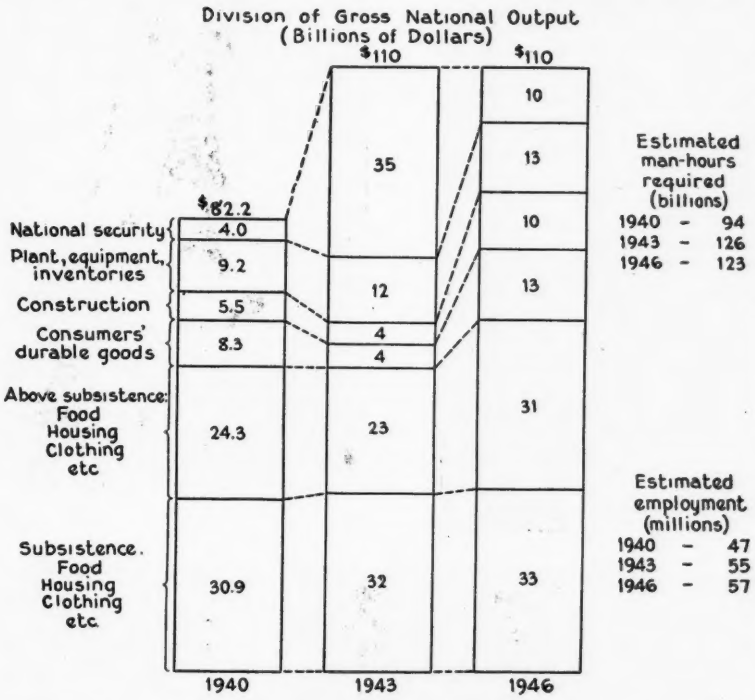


Fig. 3. A chart from D. C. Princes' paper showing the division of national income for 1940 and the possible division of income in 1943 and 1946, the latter assuming a peacetime economy

The papers relating to the economics of plant and system design and construction were all of interest. Two of these were of special significance since they dealt with distribution and distribution at the present time is a very important element in the economics of power system operation. One of these, entitled "A Forward Look at Distribution," was presented by M. W. Smith, Vice President in charge of Engineering at Westinghouse, while the other was delivered by A. E. Silver, of Ebasco Services, Inc. This address discussed present engineering opportunities in electric distribution. Among the many methods by which costs could be reduced as suggested by Mr. Silver was the use of higher voltage primary systems, bare conductors, the use of rural distribution methods in towns and cities, the greater use of capacitors and greater standardization in equipment and practices. Mr. Smith discussed similar phases of distribution practice. He listed the specific courses of action to improve distribution practice under four classifications, as follows:

1. Greater flexibility to meet shifting load requirements.

2. Planning future system modifications so as to increase investments in small increments as local bottlenecks develop.

3. The development of medium load areas.

4. The use of the many ideas and developments brought about by research in recent years.

E. S. Fields, manager of the Electrical Dept. of the Cincinnati Gas and Electric Co., discussed conservative investment for electric distribution. Despite the high cost of distribution, Mr. Fields said distribution costs are less today than they were 10 or 15 yr. ago and this trend should continue for a while at least, since more kilowatts are being delivered over the lines. After the service is available, the cost does not increase in direct proportion to the increase in energy delivered.

What Mr. Fields said about lamp flicker provided food for considerable thought. We all realize the inadequacy of present day building wiring, but it might surprise us if we knew what this inadequacy has cost us because we have tried to handle the lamp flicker problem entirely on the supply system.

Closely related to the question of distribution was J. E. Moore's paper on basic factors in power interconnections agreements. Mr. Moore, who is operating consultant of Ebasco Services, Inc., outlined certain factors and principles in agreements for interconnections of transmission facilities where the systems are concerned with non-affiliated private enterprises.

Two other papers deserve final mention: "The War and Its Financial Perils" by Carl Snyder, former statistician of the Federal Reserve Bank, was of general interest to everybody since it dealt with a commodity that is all important in all of our lines, namely, money. Not very optimistic, Mr. Snyder urged caution—curtailment of expenditure. Regardless of the outcome of the war, he felt that our present scale of war expenditures without adequate retrenchment would bring about disastrous inflation.

The other paper referred to was that on low cost housing presented by Henry J. Morton of the John B. Pierce Foundation. Mr. Morton described a 3-bedroom pre-fabricated house complete with built-in furniture, screens, storm sash, heating plant, range, refrigerator and water heater that can be sold for from $3000 to $3500.

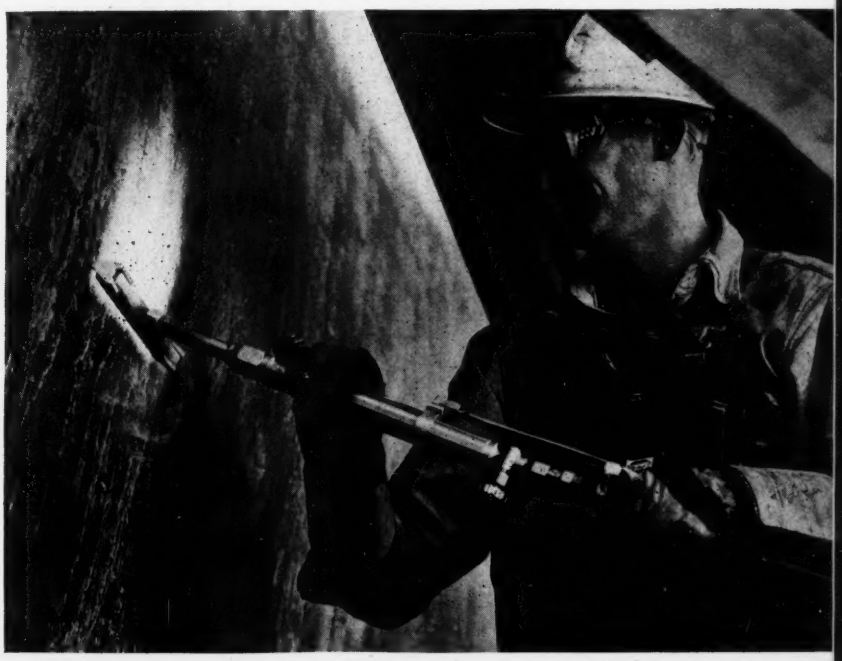
PICTURES

Above left. Like an organ console. These hands are checking De-ion arc extinguishers developed at Westinghouse to replace fuses

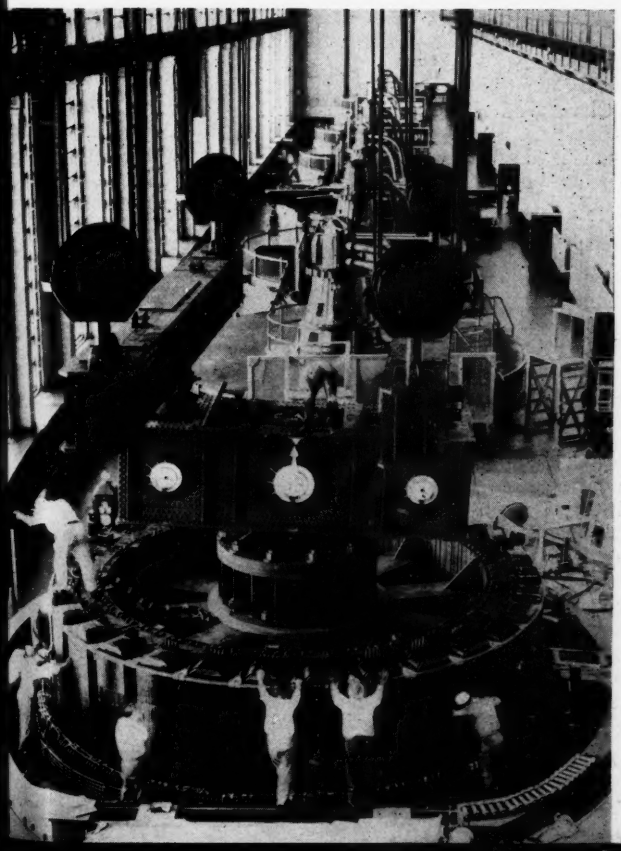
Above center. William S. Knudsen, director of the office of production management for defense, inspects a turbine rotor in the Schenectady Works of the General Electric Co. Left to right: Mr. Knudsen, J. H. Howell, chief work accountant; President Charles E. Wilson and D. L. Boyle, turbine shop superintendent

Left. Every department possible is being pushed into 24 hr. a day production at the foundry of the Allis-Chalmers Mfg. Co. to make up for time lost during the 76 day C. I. O. strike that rendered all its facilities idle and prevented the pouring of over 30,000,000 lb. of metals vitally needed for defense purposes

S Of Engineering Interest

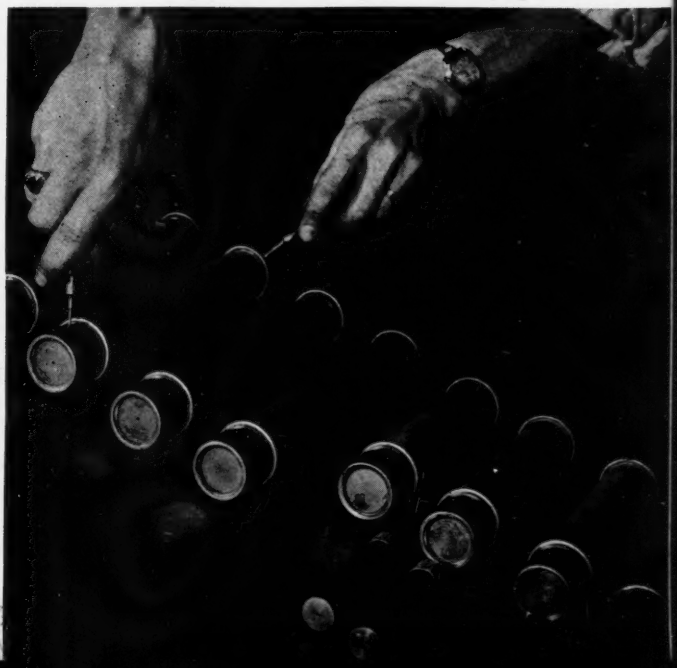


Above. The European battlefront is not the only place where fighting with fire is a daily occurrence. At Grand Coulee Dam 11 big drum-gates on the spillway section of the dam must be cleaned for painting, and cleaning by fire is an essential practice. Scales and rust on the steel are quickly eliminated by application of acetylene torches ejecting tiny jets of white hot flame reaching a temperature of 5300 deg. F.



Left. Threading the 300 ton rotor of a 42,500-hp. single phase General Electric generator at the Safe Harbor hydro station is close work. Rotor to stator clearance is only $\frac{5}{8}$ in.

Below. Like a xylophone. High voltage fuses and the hands of the test man suggest a xylophonist. The larger fuses protect power lines against lightning and electrical surges



A.S.M.E. Semi-Annual Meeting

In a double-header engagement at Kansas City, Mo., the American Society of Mechanical Engineers gathered for the Semi-Annual Meeting June 16 to 19, preceded by a meeting of the Oil and Gas Power Division of the Society

THAT THE ENGINEERS of the country are fully aware of the responsibilities placed upon the profession in the present national effort to prepare fully for defense and war, if need be, was made evident in nearly every session and committee meeting of the Semi-Annual Meeting of the American Society of Mechanical Engineers held in Kansas City, Mo., on June 16 to 19. It was only in the presentation of the prepared technical papers that the audiences were permitted to put aside for the moment the obligations engineers have in this defense emergency to supply the nation with the implements of war. In the discussion of these papers, however, there seemed always to be in the back of the speakers' minds the thought of how the information gained from the paper could be used to advantage in the national defense program.

High-lighting the meeting was the banquet and dance at which Ernest E. Howard served as toastmaster and Wm. McClellan gave a brilliant address on the subject "Professional Engineering in a Democracy." His statements were far from those of an alarmist, never-the-less he urges careful scrutiny into the turns in the affairs of state which have a tendency to deviate from our present form of government, lest tyranny take its place.

President William A. Hanley presents Fifty-year Membership Badge to William L. Abbott

At this function, also, President Wm. A. Hanley presented the fifty-year membership badge of the Society to W. L. Abbott of Chicago, a past-president and an ardent worker in the Society's affairs these many years. He also presented the Spirit of St. Louis Medal to John Elliott Younger of the University of Maryland for his outstanding accomplishments in aeronautical engineering. Dr. Younger responded by an address on "Our Unused Potentialities for Aeronautical Research and Development."

Officers Nominated

Secretary C. E. Davies announced that the nominating committee had reported the following selection of names to be voted upon in a letter ballot of the Society: For President; James W. Parker of Detroit, vice-president and chief engineer of the Detroit Edison Co. For Vice-Presidents; Clarke F. Freeman, Providence, R. I.; Clair B. Peck, New York City; Wm. H. Winterrowd, Philadelphia, Pa.; and Willis R. Woolrich, Austin, Tex. For Managers; Wm. G. Christy, Jersey City, N. J.; H. L. Eggleston, Los Angeles, Cal.; and T. S. McEwan, Chicago, Ill.

On the technical side, the meeting was filled with papers containing a wealth of information and data of practical value to those in the field of engineering. Among power plant engineers, interest centered around two groups of papers, namely those devoted to power and fuel subjects. Only brief resumes of these papers can be given here but the most important ones in these groups will be more fully abstracted in later issues of POWER PLANT ENGINEERING.

Operating experience during the first 2 yr. of service of the high-pressure, high temperature unit at Des Moines, Ia., were related by J. F. McLaughlin, mechanical engineer of the Iowa Power & Light Co. This unit consists of one 35,000-kw. turbine generator operating at 1290 lb. per sq. in. 925 deg. F., without reheat, running at 3600 r.p.m. and exhausting to a condenser. Steam is supplied by a steam generator unit which has a capacity of 420,000 lb. per hr. and burns Iowa pulverized coal.

Initial starting of this turbine took place on November 23, 1938, with steam from the 365 lb. boilers which were part of an earlier installation. The paper gave complete operating records for 1939 and 1940 which included the time, duration, and cause of each outage, major repair, and change made and the maximum daily load carried on the unit.

Continuing the studies of air-heater performance in plants at the Philadelphia Electric Co. which were last reported by N. E. Funk in 1926, E. L. Hopping and D. F. Schick of that organization presented a paper giving facts pertaining to experience gained in operation of the air heaters referred to in the previous paper; applications of new heaters to recently installed generating equipment; applications in associated industries; and trends evident in an analysis of new units. Further detail was given covering the selection of air heaters, corrosion problems, methods of eliminating corrosion, cleaning air-heater units, and troubles experienced with air-heater installations.

After defining the three basic types of water cooling equipment as spray ponds, atmospheric and mechanical draft, L. T. Mart of the Marley Co., discussed the characteristics, advantages and limitations of these types, their proper applications and the chronological development of specific features. Special attention was given to the mechanical draft towers, forced and induced, the services to which each is best adapted. He compared the old with the new, and traced the evolution of improvements in fans, motors, castings, structural design, spray drift eliminators, water distribution, noise reduction and other details.

Turbine oils of today have a longer period of usefulness than those formerly considered best for this purpose due to the stability characteristics which have been developed in these oils as explained by Howard R. Peterson of the Standard Oil Co. In his paper he reviewed the phenomena of turbine-oil oxidation, effect on turbine lubrication, and the use of inhibi-

James W. Parker, nominated for president in 1942

tors. Service data were given on inhibited, asphaltene-free turbine oil, as used in 560 turbines.

Recent advances in fusion-welding techniques, in procedures for qualifying welding operators, and in testing methods for evaluating welded joints have done much to establish the art of welding in the boiler industry on a firm basis for both new construction and for repair work, according to F. C. Hutchinson of the Linde Air Products Co. The uncertainties of many early applications of fusion welding have now been completely eliminated by carefully planned procedures, by improvements in equipment, and by the results of scientifically conducted tests. The author's discussion dealt with safe-ending practices, early code restrictions, new rules for welded repairs, welded piping, alloyed steel pipes, and short-time stress relief.

To J. Kenneth Salisbury of the General Electric Co. went the thanks, compliments and appreciation of the engineers who are beginning to get rusty in their mathematics. For in his paper dealing with an analytical approach to the problems involved in working out steam-turbine regenerative cycles, he described a graphic method he has discovered and used for determining, quickly and accurately, the improvement in heat rates resulting from regenerative feedwater heating with any steam conditions. The method is useful in estimating heat rates and in settling the design of a feedwater-heating system before final design figures are completed.

By means of a newly developed governor-analyzing instrument, A. F. Schwendner of the Westinghouse Electric & Mfg. Co., showed how it is now possible to make a check of each governor on a system. These instruments will help to locate trouble and improve performance, when used periodically. So sensitive are the indications that the disturbing effect on an entire electric system was definitely shown each time a billot of steel was sent through a rolling mill many miles away from the point where the instrument was attached.

Successful pulverizing and burning of low grade midwest coals in boiler furnaces, according to A. C. Foster of Foster Wheeler Corp., required that adequate provisions be made in the original design for the following coal characteristics: Low ash softening and fusion temperatures; negligible coking tendency; generally high moisture content; and low to moderate grindability. His studies have brought him to the conclusion that if the following conditions are satisfied there should be no serious problems for the operators to overcome in the burning of midwest coal: Large furnace volume with moderate heat release rates; ample cooling surface in the furnace; preheated air at sufficient temperature to enable the pulverizer to pulverize coal with the maximum moisture content that may be expected; and ample mill capacity to provide fine grinding with the worst coal likely to be encountered.

In the modern furnace arrangement of chain grate stokers, stated F. X. Gilg of Babcock & Wilcox Co., rear arches have disappeared entirely and front arches have been shortened until there now remains only a short ignition arch at the front of the stoker. The elimination of these arches has been accomplished gradually with a careful analysis of the factors and results involved in each case. The use of high velocity overfire air through the front arch has made it possible to maintain ignition with a minimum of arch length.

Among the materials handling papers presented, one by George C. Daniels of the Commonwealth & Southern Corp. described a number of ways in which coal is handled from ships, cars, and in storage, and cost comparisons were made. Another by E. U. Titus of Allen-Sherman Hoff Co. gave a typical example of a modern pulverized-coal-fired boiler and details of an automatic method for removing and disposing of dust and fly ash.

At the Banquet of the Semi-Annual Meeting of the A.S.M.E., W. L. Abbott was presented with the Fifty-year Badge, and J. E. Younger was given the Spirit of St. Louis Medal

O.G.P. ENGINEERS MEET

Division of A. S. M. E. Conducts Separate Convention and Exhibit of Equipment

FROM June 11 to 14 the Oil and Gas Power Division of the A.S.M.E. held its fourteenth national meeting and exhibit in Hotel President, Kansas City, Mo., where its program of fourteen papers attracted an attendance of over 225 engineers.

Chrome plating of cylinder bores had its advocate in H. van der Horst of the Van der Horst Corp. of America, who stated that the purpose of chrome-hardening cylinders is to bring about a reduction in the wear of cylinders, piston rings, and piston ring grooves. Because of the increased heat flow and the totally different lubricating conditions, there being no lubricating stroke between the firing strokes, the wear in two-stroke-cycle Diesel engines is more serious than in the four-stroke-cycle type.

No small part in the development of Diesel engines has been played by the new instruments that have been adapted for use in the laboratories of manufacturers and many new types of field instruments have been developed which are of great help to operators in maintaining efficiency and reliability of Diesel engines in service. C. R. Maxwell and K. M. Brown of Caterpillar Tractor Co. described the instrumentation used in the development and testing of Diesel engines; inspection instruments and procedures for Diesel engines were described by E. R. Spencer of the Cooper-Bessemer Corp.; instruments and automatic control apparatus for Diesel engines were treated by W. H. Sisson of Minneapolis Honeywell Co.; and B. H. Jennings of Northwestern University and T. E. Jackson of Lehigh University presented an analysis of Diesel engine performance using release-pressure measurements secured by the application of a new type of pressure indicating instrument.

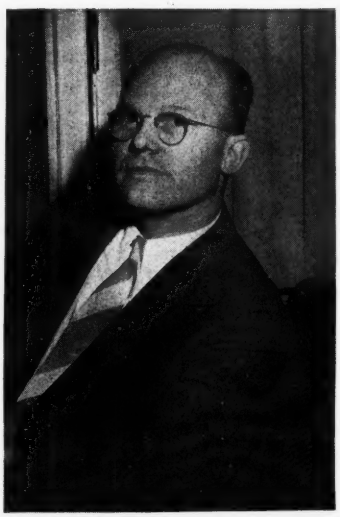
W. L. H. Doyle, elected chairman of the division for the coming year

Engine foundations when properly designed perform two purposes, according to Kenneth H. Larkin of Burns & McDonnell Engineering Co. Simply stated, the foundation furnishes a place to set the engine, and it acts to reduce or isolate the vibration of the engine due to the dynamic unbalance of its moving parts. The general features of the site as affecting the allowable vibration and the character of the subsoil to respond and transmit vibration should always be considered in the purchase of the engine. A foundation can be designed for any engine at any site, but if conditions are such that vibration of adjacent structures is undesirable, or if the subsoil is of a type to respond to and transmit the engine vibrations, then the purchase of an unbalanced engine is poor judgment, because all the methods of foundation design and vibration isolation can never be a proper substitute for engine balance.

H. van der Horst, lead-off man in the technical program

G. C. Boyer, of Burns & McDonnell Engineering Co., chairman of the arrangements committee

Maintenance of lubricating oils for Diesels was given consideration in two papers. C. W. Bryden of the De Laval Separator Co. advocates purification of oil by the centrifugal method. Clean engines and well conditioned lubricating oils can be economically achieved, he thinks, with a centrifugal purifier operated at a capacity from one-third to one-half of its Navy rated capacity.



C. W. Good, under whose chairmanship the division has functioned during the past year

As an advocate of the filtration method of maintaining lubricating oil, Walter C. Bauer of Briggs Clarifier Co. gave a dissertation on the impurities that accumulate in Diesel oils while in use and came to the conclusion that the safest, easiest and most practical way to remove acids and gums from the oil is by contact with active clay—by absorptive filtering.

Supercharging came in for discussion at the last session of the meeting when two papers were presented, one by J. B. Harshman of the Stanolind Pipe Line Co. on Operation of Supercharged Engines in Pipe Line Service, and the other on Test Results with Under-Piston Supercharging prepared by E. S. Dennison and W. A. Morain of the Electric Boat Co. These papers and the discussion which they precipitated indicate that sufficient experience has been gained from present installations to prove that this method of increasing the horsepower of non-supercharging units is not only practicable but in many cases economically justified.

Next year the meeting will be held in Peoria, Ill., which is the home city of the newly elected chairman of the Oil and Gas Power Division of the A.S.M.E., W. L. H. Doyle of the Caterpillar Tractor Co.

BACK to SCHOOL

With skilled men at a premium U. S. Steel steps out and expands its training program. Over 15,000 employes learn—the practical way in the shops—from men who know how

Fig. 1. How to lay brick properly is shown to apprentice Harry Floyd by H. D. Tyson in a Birmingham plant of the Tennessee Coal, Iron & R. R.

Fig. 2. On the Pacific coast Patternmaker Jerry Becker (left) explains blueprint reading to Don Thacher, Columbia Steel plant apprentice

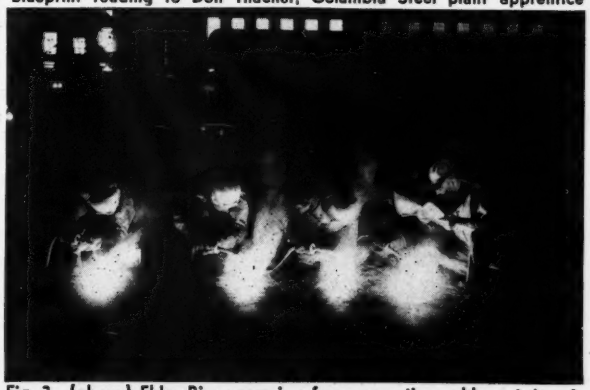


Fig. 3. (above) Elder Rice supervises four apprentice welders at American Bridge's Ambridge, Pa., plant. Fig. 4. (below) Apprentice Bernard Hines learns to undercut a commutator at a Gary mill of Carnegie-Illinois

ONE OF THE serious potential bottlenecks of the defense program, one which may well become even more critical, is the shortage of skilled men, engineers, mechanics, electricians, etc. Under the direction of the U. S. Department of Education, various schools and colleges organized practical training classes. The program has been under way only a few months but the millionth student was graduated late in May—1,000,000 as compared to 60,000 during the corresponding period in the World War.

A factor of considerable importance in this connection was, and still is, the difficulty of getting employers interested in estimating their labor needs 6 mo. ahead. Only if this is done can training programs of the proper type be put into effect during the waiting period. Another problem is a supply of machines for training purposes. This depends to a large extent upon the active co-operation of nearby industrial plants. Production cannot be stopped for this, of course, but classes can often be fitted in at odd periods. Paper mill repair machine shops, which are used but infrequently, are being utilized to train shipyard machinists while the yards are being built.

Many of the larger companies have their own schools. One of the largest of these industrial programs is being conducted by the subsidiary units of the United States Steel Corp. practically on a nation-wide basis. Several views of the corporation's school activities are shown by the accompanying views. Employe training is of two kinds: that involved in fitting a man for the next higher job in regular mill operations; and, that required to equip a man to handle a special defense operation.

The fact that such a training program has long been in effect made it possible for the corporation to increase its output, in a little more than 6 mo. time, from two-thirds to full capacity.

As a preliminary to learning these operations, many of the men are given training in machine operations in the public schools or in the company machine shops. This kind of training, as well as the upgrading of men in regular mill operations, is separate from the subsidiaries' long-range apprenticeship program where more than 1300 apprentices are now taking 4 yr. courses in steelmaking in steel-fabricating units of the corporation.

Many employes are supplementing their training by taking academic work. More than 5000 are receiving classroom instruction directly related to their jobs on company time. Nearly 10,000 are pursuing studies on their own time. More than 2500 of these are taking emergency defense courses now being conducted in trade schools, high schools, and colleges under the national defense training program.

Wartime Trouble Shooters

(Continued from Page 50)

ized to supply power to the Pilsudski-Platz and Hotel Europa on Oct. 2.

The power plant itself, with 107,900-kw. of capacity, however, was in bad shape: the roof burned off; all 20 boilers unfit for service; two generating units hit squarely by shells; all units damaged by artillery fire; a transformer burned out and a main feeder shattered. Holes in the boilers were welded. On the 5th two generating units were put into service; on the 12th another; and by the end of the month 50,000-kw., equal to the peak demand of that city before the war, was available. In the meantime a 20,000-kw. transmission line from Prusszkow was repaired and put back into service. From the 2nd to the 12th power production increased at the rate of somewhat over 40,000-kw-hr. per day.

Outside of the complete destruction of the filters by artillery fire, the chief difficulty with the water supply system were the lack of power for the electrically driven pumps. Repairing the damaged piping system was more hazardous than difficult due to the many collapsed houses. However, service was started on Oct. 4 with four outlets supplied by old steam pumps. Because the filters had to be bypassed the chlorine treatment was increased from 0.3 to 0.5 mg. per liter. Service was restored to the city at the rate of about twenty-five city blocks per day through street outlets. Shortly after the middle of the month treated and raw water combined equalled the pre-war requirements of about 26 m.g.d.

Pipe Line Shell Damage

Worst of all was the artificial gas plant with a normal daily output of about 50,000,000 cu. ft. of gas. The gas holders were burned out; coal and coke storage was on fire; the chemical plant in ruins; furnaces damaged; nearby grain elevators on fire. Even coal yet unloaded from the cars was on fire, "without the Poles giving any thought to extinguishing them." Gas piping system (total about 450 mi.) in the city was found broken in more than 1000 places due to direct hits or concussion breaks. The latter, which were extremely difficult to locate, occurred up to a radius of as much as 35 ft., depending on the caliber of the shell.

However, by utilizing an old engine out of service for 14 yr. in a nearby textile mill, working day and night; blanking off the high pressure gas lines and old boiler drums for storage purposes; some gas was manufactured on Oct. 11 and supplied to limited districts on the 17th. By the 25th, some 263 houses with 2935 apartments; 434 street lights (out of a total of 7200); three hospitals; the city bakery and one machine shop were connected to the gas system.

The sewage system is in two levels, one drained by gravity one pumped by an electric driven pumping station. Main collecting sewers from 20 to 30 ft. deep were caved in in 28 places; secondary collecting mains in 159 places; and cast iron headers from the pumping station broken in four places. Three shifts worked to clear obstructions, working at the points of greatest danger first, until the danger of flooding the cellars and streets was past. The pumping plant itself was damaged only superficially and was available for service as soon as power was available.

Food Distribution

Limited operation of the street and suburban railways was also put into service as soon as power was available. An important part of the work was providing food for the laborers. This was not for humanitarian but for practical reasons. The Poles, while non-co-operative, were hungry and weak from lack of food. "Discharging the workers after a few hours of heavy labor to which they were not accustomed, to take on others . . . was followed when it was realized that by providing ample food the same workers would return . . . This began on the second day after starting work." Ample food was "one hot meal at noon; in addition bread issued from stock . . . "

While the damage in Warsaw was not comparable to that in, say, the central section of Rotterdam or London after intense aerial bombing, it offered the first opportunity to demonstrate how, and in what time, a large city subjected to siege could be made livable again. In this case approximately a month was required for a quite complete restoration, a period approximately twice the length of the siege. A reasonable degree of service was, however, available in half that length of time.

Poland, France, Holland, Greece, Crete—all offer grim evidence that today the success or failure of the combat forces must be shared with highly complex industrial organizations behind the lines. These organizations produce machines of modern war and blitzkriegs: tanks, submarines, battleships, aeroplanes, bombs, mines, armament and rapid transportation.

Civilian Responsibility

Once produced and delivered, the responsibility for effectively controlling and maintaining these machines is up to the military forces, yet the civilian engineer's responsibility does not cease. Maintaining mechanized armies of millions of men with a continuous demand for food, munitions, repair parts and replacements is responsibility equal to the original production. To this must be added a third responsibility, maintaining the civilian organization itself.

Nor can those behind the lines forget that the space shrinking aeroplane can be, and is being, turned against them. One well placed aerial bomb can spread death only over a limited area, but, it can stop production over a wide area by disrupting the finely balanced industrial machine. Thus while maintaining maximum production, the industrial machine itself must be rebuilt to withstand these new conditions. The conspicuous, centralized industries of peacetime must give way to the blackout and camouflage, with units widely scattered so as to be less vulnerable to attack. Already these precautions are important phases of our own new defense building.

Power Is Essential

Of the many branches of engineering involved, none is more essential than power production and distribution. Without power to turn the wheels of industry, production stops. Equally important, the various services, gas, water, sewage and transportation, which make it possible for large numbers of people to live in congested areas without plague and pestilence, break down. When the civilian industrial organization ceases to function, the whole military machine bogs down.

Magnet Coils and Related Data

(Continued from Page 63)

These two materials are, therefore, more and more extensively used, particularly the acetates, as they lend themselves quite readily to moulding, hot forming, cutting, bending and practically all other manufacturing demands. The acetates' most serious fault is the fact that embrittlement and shrinkage are apt to be severe when used above 100 deg. C.

With the above physical characteristics disposed of let us consider some of the basic formula from which electro-magnets and, to some extent, coils are calculated. These formulae are but few in number, and should be permanently fixed in the minds of those who deal with electro-magnetic design. First, the pull in pounds formula which for all practical problems may be written:

$$P = \frac{B^2 A}{72 \times 10^6}$$

where P is the pull in pounds, B is given in lines per square inch and A is area of core in square inches. Of course, B equals $\emptyset/A$ where $\emptyset$ equals total flux. These formulae are useful in checking theoretical pull produced by a coil on a given magnetic structure. As the effectiveness of a coil is usually measured in ampere turns, we should also keep in mind that $\emptyset = \frac{\text{M.M.F.}}{\text{Reluctance}}$ or in terms of ampere turns, which is the practical measure used.

$$\emptyset = 3.19\ A\ N\ I \div L$$

Where L is the air gap in in., I is in amps. and N is coil turns.

Actual ampere turns required to operate a magnet usually varies, particularly on alternating current to as high as three times the calculated value, due to flux leakage or the magnet designer's inability to fully utilize all the magnetic flux created.

This is a point little appreciated but forcibly demonstrated by the formula

$$E = 4.44\ f\ N\ \emptyset \div 10^8$$

which may be written

$$\emptyset = E\ K \div N$$

Where $K = 10^8 \div 4.44\ f$ and f = frequency.

The significance of this formula is that for a. c. circuits magnetic flux is independent of all factors but voltage and coil turns and is constant at all times regardless of magnet position, open or closed, type or wire, rivets, pole shaders or any other electrical or physical considerations.

With the help of these formulae and some assumed value of flux density, usually fixed at, or slightly below the knee of the saturation curve for the particular steel used, a design may be roughed out, later to be built and tested, and most usually changed or modified before the finished product agrees with all of the demands of the magnet designers, factory planners, commercial people and others who must be consulted as to the type, size, appearance, etc.

We shall see more of the details of design and the determinations of coil constants in the next section, but before getting to that, it might be well to remember that actual commercial coil design is by no means an exact science and the data to follow is indicative of trends in a general way, and only approaches exactness for lines or types of coils where one or more of these have been checked and their characteristic data related to that presented. It is meant by this that such factors as physical peculiarities or unique service conditions may well make the heating, cooling and rating data differ from the curves given but usually only as to numerical value; the trends still remaining unchanged.

In this connection and to further emphasize the fact that coil design is at best a series of successful compromises, it may be well to note that the usual lengthy, and as far as actual work is concerned, none too accurate formula, covering determinations of wire size, turns, space factor percentage, voltage rating, current density, etc., have been purposely omitted. These formulae are too well known, and in a field of constantly changing insulation standards and radical winding machine developments, of but little value except to the novice, who, of course, should study such data in the interest of balance and proper evaluation.

Blackout Construction

WINDOWLESS BUILDINGS, completely air conditioned and lighted artificially, have been in rather common industrial use for a number of years, for no reason except that accruing from uniform temperature and humidity conditions on workers and process work. Recently this "blackout" construction has assumed new significance. While retaining all former advantages, it is also an effective night protection against aerial bombing.

Several new plants of this type have recently been announced; a new fluorescent lamp plant where it is desirable for the control of dust; a new power plant; a new naval arsenal for the manufacture of precision instruments; and a new airplane factory.

This latter, the new Douglas Aircraft plant now nearing completion on a 200 a. plot near Long Beach, Cal., is unusually interesting because it is designed for the dual purpose of increasing production and to give maximum protection against bombing. The plant will consist of 11 windowless buildings, well separated so as to confine damage from a bomb to a relatively small part of the whole manufacturing process.

With a central air conditioning plant a single lucky bomb might conceivably put the entire air conditioning out of operation and seriously cripple the factory operation. Therefore, the air conditioning equipment will consist of 35 complete Westinghouse systems, with a total refrigerating effect of 2400 t. plus 33 York V/W units totaling 2000 t. Refrigeration of 2400 t., by the way, is equivalent to melting, in 24 hr., a block of ice 12 ft. square and about 580 ft. high—higher than the Washington Monument.

The air circulation involved amounts to some 56 t. or 1,400,000 cu. ft. per min. The air will be cooled in the summer and warmed in the winter, steam for the heating coils being supplied from separate plants in each building.

In order to save space which could otherwise be used for manufacturing tasks, the air conditioning equipment is being installed in the roof trusses. In the larger buildings some are 40 ft. above the floor. L. N. Davis, plant engineer for Douglas, reports that three shifts of men are installing the equipment as fast as the buildings are ready—which in the aeroplane industry means practically right now!

Erwin Grey, *is C.E. of the Bear Brand Hosiery Mills at Kankakee, Ill. . . . Chanute Field, the Army ground school (see Oct., 1940, issue) seems filled solid with barracks and the interstices packed with autos . . . two autos where one stalk of corn formerly grew . . .* **Chas. E. Markland,** *Chief Mech. Eng., Univ. of Ill., uses the degree day in heating calculations . . . but he planimeters the daily temperature charts . . . for extreme temperature changes this method differs from the short cut method used by the Weather Bureau by as much as 5 deg. . . . Guarding power stations against sabotage formerly under the wing of the Plant Protection unit of F.B.I. has been taken over by the Fed. Pow. Comm.*

Elmer Reuther *is superintendent of the Moline (Ill.) Water Power Co. plant now being rebuilt . . . Four new Kaplans replacing 20 old geared wheels . . . Next door at the Moline Steam Plant, Moline-Rock Island Mfg. Co. . . .* **Sidney Scammon** *and* **Rex Sayre,** *recently of Riverside Station, are, respectively, superintendent and engineer . . . They have two new 800 lb., 100,000 lb. per hr. B. & W. boilers, each fired by 5 section Firerite spreader stokers . . . A 15,000-kw. (0.7 pf.) Westinghouse turbine later.*

Paul Woodnorth, *Prod. Eng. Interstate Power Co., Dubuque, Ia., reports 3 jobs underway . . . At* CLINTON *one 45,000 lb. per hr. Riley pulverized coal semi-outdoor boiler just being completed . . . 150 lb., 500 deg. F. at present, eventually 450 lb. 825 deg. F. later . . . At* DUBUQUE *a 150,000 lb. per hr., C.E. pulverized coal unit . . . 275 lb. 580 deg. F. now, 675 lb. 900 deg. F. eventually . . .* **L. P. Harlan,** *formerly of Bismark, N. D., is station supt. . . . At* ALBERT LEA, *a 90,000 lb. C.E. oil and gas fired boiler, 450 lb. 825 deg. F. . . . 7500-kw. G.E. turbine and C. H. Wheeler cooling tower . . . Last two jobs Sargent & Lundy . . . Clinton handled by company engineering dept. . . .* **A. M. Waldie** *is Chief and* **R. M. Hanson** *results engineer at the new French Island Station . . . N.S.P. Co., La Crosse, Wis. . . . Down the river a bit at Genoa . . .* **J. A. McCasland,** *formerly at Cahokia, is supt. of the new Tri-State Power Corp. plant . . . R.E.A.'s* **Franklin P. Wood** *says the station will probably be dedicated July 4.*

E. Winholt *of John Deere & Co., Moline, Ill., is getting ready to put a new 75,000 lb. Springfield boiler with Firerite stoker, Diamond soot blowers and Cash control in the company's Waterloo, Iowa, plant . . . 225 lb. pressure, 100 deg. F. superheat . . . Over on the Mississippi at Keokuk,* **H. E. Nelson,** *supt., The Hubinger Co., is doing the same with a 150,000 lb. unit . . . thought to be the largest spreader stoker unit yet sold . . . More details later . . . Just to keep the record straight, the* **Mr. Sherman** *in the Eng. Dept., The Hobart Mfg. Co., Troy, O., is* **John M.** *and not Tom as reported previously . . . and he's a West Pointer . . . and speaking of the Army, another of our lubrication authors . . .* **Harold E. Rose** *. . . is now in the Army commanding a light maintenance company.*

'Round About

with the Engineering Editor

WASHINGTON in the springtime is, literally and figuratively, beautiful but hot . . . Social workers may rave at its low morals, health and living standards, but on the surface it's brimful of healthy, happy Americans . . . some busy workers, some busy sightseers . . . cars from every state in the Union . . . beautiful parks . . . a tradition of 150 yr. set off by modern air conditioned buildings . . . Incidentally, the President is satisfied with Nature's weather whims . . . air conditioning in the Executive Wing of the White House, does not extend inside his office door.

It is a city—a Capitol city—of life and beauty that every American may well feel proud of . . . For purely sentimental reasons the Capitol burning, buildings in ruins, parks dug up and statues overturned by bombs is not nice to think of . . . Perhaps this is why people there take defense so seriously.

What is official Washington thinking? Those who should know say that to find out one must look at Washington from the outside . . . Still it is my impression . . . bear in mind a purely personal impression formed first hand from contacts with a score of individuals . . . Tops—from the President on down through O.P.M. and half a dozen regular departments . . . that those in Washington doing the work are thinking only of Production and more Capacity of all kinds . . . The balance is not my opinion but what I've been told, as of June 1, by those that should know.

The Defense Program? Well in hand, everyone feels . . . 3 mo. ahead of the World War first year effort . . . some phases, like ordnance 9 mo. ahead . . . Materials? Many critical and will get worse—non-essential—non-military output likely to be drastically curtailed . . . Tanks production? Program behind original schedule . . . Why? . . . Not enough material to do everything at once and military men said requirements today are such that tanks can go second class.

Labor? Looks nasty on surface from a few bad spots, but well in hand . . . CIO-AFL have a moritorium on jurisdictional defense strikes . . . Congress in a mood to back strong action to prevent defense delays . . . Last year, for every day lost time due to strikes, there were four lost due to partial disability accidents . . . 47,000 man years of production lost . . . 95 per cent avoidable . . . Big labor problem is training both laborers and management . . . labor to do specific jobs . . . management of small plants, to plan ahead.

Price fixing? OPACS is confident it has the authority both under the President's emergency powers and the Selective Service Act . . . Equally confident that authority will not have to be used.

Taxes and inflation? No inflation if Congress and the Treasury Department can prevent it . . . The idea is you'll pay immediately about ⅔ of current defense cost, the other ⅓ will be borrowed . . . but defense costs are rising so rapidly this ratio will fall by the wayside . . . Next year 3½ billions in taxes will be added to the current 9 billion plus . . . How? Approximately 1½ billions from income tax, 1 billion from corporation taxes, ⅓ billion from estates taxes and balance from excise taxes . . . Much of the increase will be in form of surtaxes so as to catch certain forms of tax exempt securities.

Speaking of income tax . . . Did you know that there are about 30,000,000 families and 10,000,000 single individuals in the U. S. . . . That more than 50 per cent of these two groups have an annual income of less than $1250 . . . and only about 10 per cent have an annual income of more than $2500 . . . Approximately ½ per cent have $10,000 a year or more . . . Compared with the average, engineers are living the life of Riley . . . 1929-34 figures on questionnaires sent to some 50,000 engineers showed . . . 50 per cent made over $3412 . . . only 10 per cent less than $1878 . . . and 10 per cent more than $7466.

Sales Tax? Possible but not probable . . . General agreement that food and necessities would have to be exempt . . . Also government buying . . . balance caught easier by excise tax with existing and simpler administration and collection problems . . . easier to drop after emergency is over.

Cost of living in Washington? Well, cigarettes are 2 packs for a quarter . . . gasoline 16½ ct. a gallon and haircuts (so the signs say) 35 ct. . . . Pickets still picket the White House . . . and super-pickets picket the pickets with a sign "We Americans Protest against Communists Picketing the President" . . . Through it all Officer 42? rides—blithely—the wrong way up a one way street until another officer points out the sign . . . he turns redfaced.

Richard H. Morris

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

RESOURCEFULNESS AND NATIONAL DEFENSE

THESE DAYS when material and equipment is hard to get engineers have to be even more resourceful than they are in ordinary times. If certain materials cannot be had they have to use substitutes; if certain devices are not obtainable, other arrangements have to be made. At times the engineer has to readjust his idea of economy to meet emergency conditions. In some cases where material has, say, a normal life of ten or fifteen years, it may be necessary to use substitute material which may have a useful life of only 5 years. Ordinarily, a conscientious engineer would not think of using such material but if it is a question of keeping the plant running or of shutting down, it is obviously good practice to use such material. During recent months we have come across a number of instances of this kind—cases where substitute materials have been used or where home-made arrangements have been made to serve. Some of these have been highly effective and since they would be of interest to other operators we make an appeal to all who have done work of this character to send in brief descriptions of what they have accomplished in this direction. We will be glad to present such descriptions in this section. By sending in such material you will not only be helping fellow engineers but you will be serving the cause of national defense in the way that you are best fitted to serve.

A. W. K.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

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THE STACKS OF ALAMEDA

OR A RIGGER'S PARADISE

By CLAYTON M. ALLEN
Assistant Mechanical Engineer
Bureau of Power and Light
Los Angeles, California

REPLACING 100 tons of riveted steel stacks with new electrically welded sections on the top 111 ft. of seven 200 ft., 8 ft. 6 in. inside diameter smoke stacks on the Alameda Steam Plant of the Los Angeles Bureau of Power and Light proved to be an unusual and interesting maintenance job, one not performed as regular routine work. The 70,000-kw. Alameda Steam Plant is located near the heart of Los Angeles, just on the outskirts of the business district. The seven reconstructed stacks, together with twenty-eight smaller stacks towering from the plant, made the workers feel like "steel jacks", akin to lumber jacks in the more familiar western forest.

The old riveted sections, erected and placed in service in the fall of 1922, were corroded on the inside of the plates as a result of gases formed from the products of combustion, and their original thickness reduced from 50 to 100 per cent. This rusting action caused the lap joints of the old plates to expand leaving a ⅛ in. strip of corroded and rusted material between the plates for the entire ring of the lap.

Test holes had been drilled periodically through the plates to study the rate of corrosion and rust in the different parts of the stack, and resulted in the decision to change the top portion of these stacks at this time. During the plant shutdown the lower portion of the stack, which remained intact, was sandblasted inside and painted inside and out.

This lower portion of the stack was not replaced for two reasons: first, the $\frac{5}{16}$ in. plate, as originally installed, was thicker than the middle and top ¼ in. and $\frac{3}{16}$ in. sections respectively, and second, the deterioration had been less, due to the fact that this portion of the stack, being closer to the boiler, was not conducive to such severe corrosive action, which is prevalent during low load or idle, and consequently low heat conditions. Seven sections of the 111 ft. of new stack were of ¼ in. plate, 8 ft. high and eleven sections of $\frac{3}{16}$ in. plate, 5 ft. high. The top five sections were fabricated in halves to facilitate erection.

All stack sections were rolled from A.S.T.M. A-7-39 plate. Although the old stack sections were in 5 ft. heights, the increase to 8 ft. for the seven lower sections of the new stack reduced the cost of fabrication and erection. Joints on the new sections were butt strap type with butt welds inside and lap welds outside.

All shop welding was done by the shielded arc process with one pass using a back-up strap if machine welded, or two passes, if hand welded. All joints were specified to equal plate strength and welders were qualified under A.S.M.E. code for unfired pressure vessels, Paragraph U 70, 1937 edition. Each circular section in the stack was fabricated with four 2½ by 2½ by $\frac{5}{16}$ in. tee iron clips 3 in. long, temporary tack-welded on the inside of the top of each section with a ¾ in. diameter hole drilled in the stem for use in handling, and for inside work-

Fig. 1. Setting the first new electrically welded section on top of the lower portion of the riveted stack left in place. The top 111 ft. of seven stacks were rebuilt in this way. Note the structural horizontal stack bracing

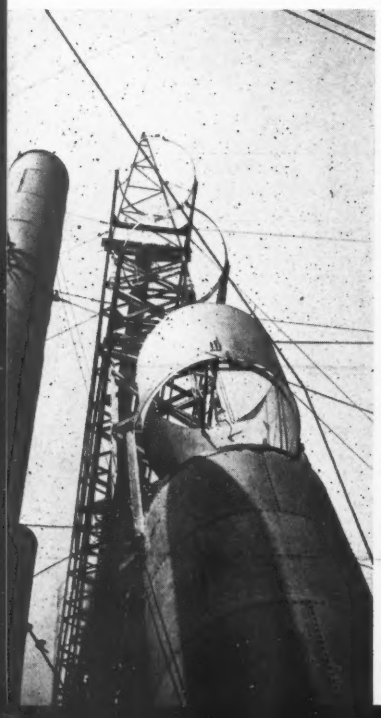


Fig. 2. "Pass" holes for welding cables or hose for sandblasting and hoisting ropes are run through holes quickly cut in stacks. "U" bolts for attaching temporary blocks, and snub lines, are quickly attached by welding

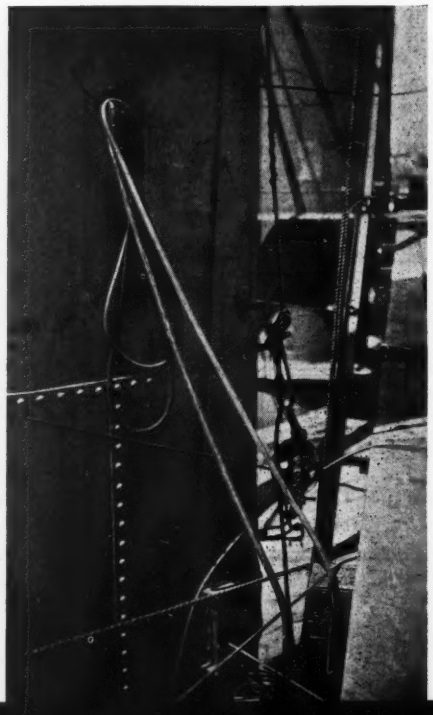
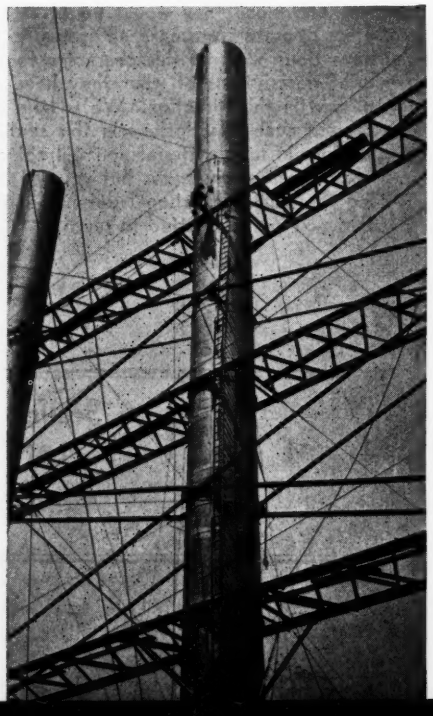


Fig. 3. Putting on the final coat of Ferrabon Gun Metal stack paint on the outside. The most striking feature of the whole reconstruction was the use of new methods made possible by the free use of electric welding equipment



ing scaffold hanger supports. A ⅛ in. spacer was welded to each clip to space the horizontal butt joint for field welding. The butt strap was 3 in. wide and was welded to the bottom part of the section so as to facilitate erection.

The Southwest Welding and Manufacturing Co. fabricated stack sections in their Alhambra, California, shop. All sections were sandblasted by the manufacturer both inside and out, and one priming coat of Ferrabon Gun Metal Stack paint was applied at least 72 hr. before shipment by Bureau truck to the job.

Before dismantling operations were started, careful studies were made and a plan of procedure adopted to insure continuity, smooth operation and safety during construction.

It was necessary to cut the structural steel stack bracing free from each stack as it was replaced, and temporary shoring was installed. The bottom of three horizontal stack bracing struts were detached from the sections of the stack to be replaced and attached to the top section of the old riveted stack that remained unchanged by diagonal angle iron braces. They were welded in position and remain as a part of the permanent structure. The temporary wood shoring which held the upper two horizontal struts in place during construction operations were located over the point where these diagonal iron braces joined the bottom horizontal strut, and was designed to carry all additional loads incident to construction activities.

The removal and transfer of stack guys was very carefully handled, particularly those transverse to each row of stacks. As the old stacks were disassembled by the acetylene torch, and the new stacks erected, the guys were transferred to and from the stacks and located as near to their permanent positions on the horizontal stack-supporting structures as possible.

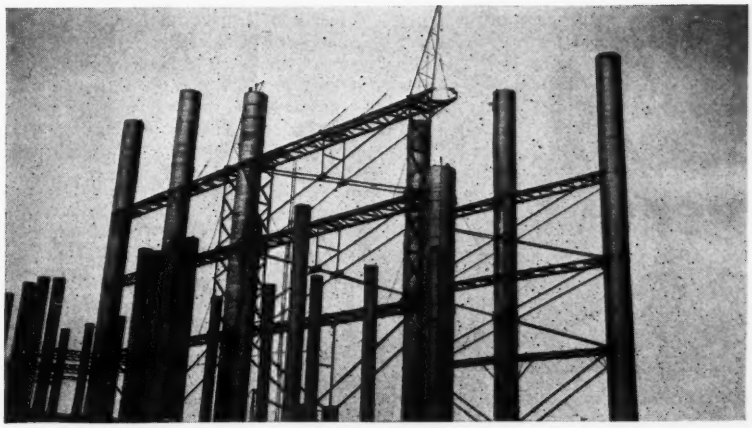


Fig. 7. Taking down the last of the seven old riveted stacks. All but the last section of the new electrically welded stack to the left are in place

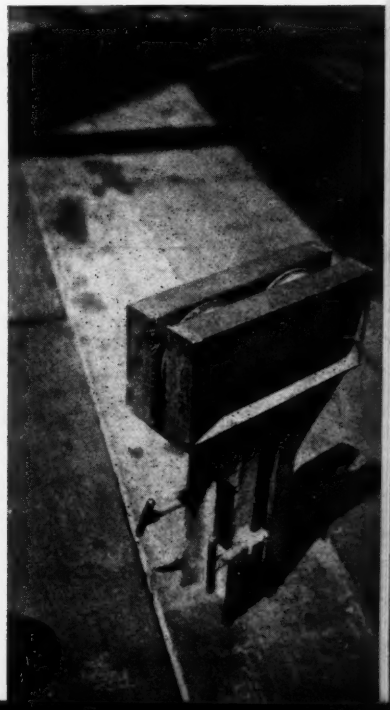
In handling the top 25 ft. of stack, a modified jenniwink fabricated from 2½ in. and 3 in. iron pipe was used, being supported by a platform suspended inside the stacks. The balance of the stack sections were handled by welded pipe "A" frames set on the top stack-supporting structure directly above the temporary wood shoring adjacent to each stack. Power was furnished by a gasoline driven, double-drum winch, the load lines going through "pass" holes cut in the stack or over the top of the stack using special fabricated steel sheave blocks which were attached to the stack at the "pass" hole or straddled the top. All hoisting operations were carried on from temporary platforms erected on the power plant roof.

New sections of stack were hauled by truck to the yard adjacent to the plant and raised by an air hoist to the temporary platform. From here they were rolled to positions beside the stacks for hoisting into place. Two working platforms were used inside of the stacks, one suspended below the other, with a manhole in the upper platform. The sections were set and tack-welded from the upper platform, and finish welded from the lower platform, thus expediting the work and minimizing plant shut down.

Fig. 4. A number of special field fabricated pulley and sheave arrangements were developed for this job. This view shows a permanent tiller-rope pulley arrangement for each stack. Other devices are shown in Figs. 5 and 6

Fig. 5. Special field fabricated sheave blocks were electrically welded for attaching to stacks where a pass hole was cut for hoisting line or where the line went over the top of the stack. Note the entire absence of rivets

Fig. 6. This view shows another of the special field fabricated sheave blocks similar to the one in Fig. 5. These were easily and quickly made and proved invaluable in carrying out the work. They were equally easy to remove



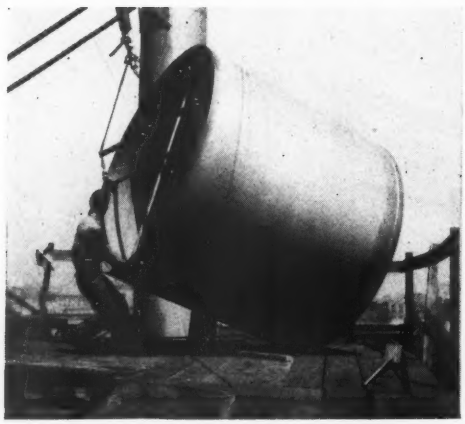


Fig. 8. Standing a stack section on end ready for hoisting into position. Note lifting bail, spreaders and temporary lugs

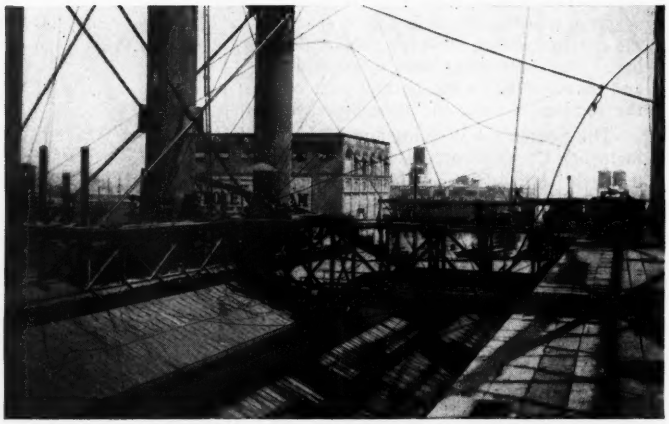


Fig. 9. Temporary staging and platforms erected and used by construction crews. Note drum hoist and electric welding machines

The field welding procedure was to tack-weld the butt joint inside and then completely fill with weld metal making a flush joint. The half sections were tack-welded together and to the lower section before completing the inside weld. After completing the inside welds, the outside vertical welds were made. The bottom of the butt strap was not welded.

After being tack-welded so as to withstand the weight of the next one or two sections, the inside welding was carried forward during the day shift, thus eliminating overtime work, and at such times as did not interfere with the erection and placing of sections.

A ⅜ by 3 in. ring was welded to the top section projecting ½ in. above the stack plate, for use as a permanent track for the tiller rope pulley. All field welding was done with $\frac{5}{32}$ and $\frac{1}{8}$ in. Fleetwood Nos. 5 and 7 rods.

No particular difficulties were encountered by the Bureau's forces during this repair work. The nature and location of the work required precautionary and safety measures be taken at all times, and the accident free record on this job speaks well for the supervision and personnel as a whole.

More than ordinary interest to steel fabricators and the welding industry was the free and unlimited use of electric welding as a tool in fabricating many gadgets in the field as well as welding "U" bolts and hooks to stacks and structures at exactly the location for effective rigging, and in less time than it took to decide on such a location.

Of importance is the fact that they were left in place for future rigging operations, with the exception of "pass" holes, over which cover plates were welded.

A final coat of Ferrabon Gun Metal Stack Paint was applied by hand inside and out. This plant was supplied by Scriver & Quinn, and was selected after satisfactory tests over a period of 2 yr. by representatives of the Bureau proved its lasting qualities for this use.

A further and important use of welding was in sealing the top of all existing steel bands, which connect the structural steel stack-bracing to the new stacks, this was done to prevent moisture from getting between the bands and the stack, thus eliminating possibilities of corrosion.

Design specifications were prepared by W. A. Shelton under W. C. Rowse, in charge of Steam Plant Engineering, and Charles P. Garman, Assistant Engineer of Design.

Construction activities were under R. R. Robertson, Engineer of Design and Construction, G. E. Benkesser, Superintendent of Construction, with field operations being carried on by Charles W. Ragan, Construction Superintendent.

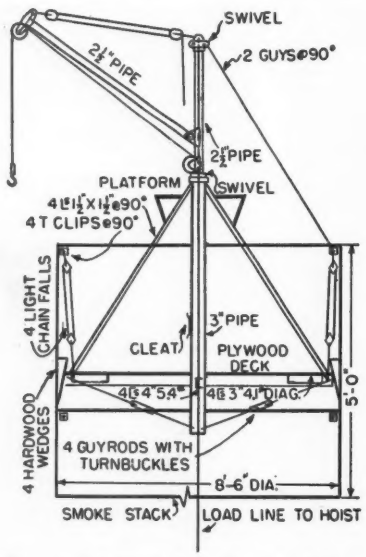


Fig. 10. Modified Jinniwink and platform

FOR THE PLANT ELECTRICIAN

Electrical Welding—What Price Failure to Warn Employe of Danger

Leslie Childs

GENERALLY SPEAKING, an industrial employer is in duty bound to furnish his employes safe appliances and a safe place in which to use them. Further, he is required to warn an employe, especially where the latter may be inexperienced in the work, of danger in the employment of which the employe is not aware. So much for the general rules.

And nowhere have they a wider application than in the hazardous phases of the electrical industry involving the use of current. Here it takes very little in the way of negligence, or even non-attention on the part of an employer, to saddle him with liability should injury to an employe result therefrom. To illustrate, consider the following case:

Inexperienced Employe
vs.
Electric Welding Machine

In a recent case, the plaintiff was, apparently, employed by the defendant, an industrial firm, as a laborer. And, while he had had some previous experience in operating an acetylene torch in welding operations, he was wholly inexperienced in the use of electric welding machines.

Upon a certain day, plaintiff was directed by his immediate superior to assist another employe, a welder, in the operation of an electric welding machine. The work involved the welding of flues to be placed in a boiler.

In performing this work, the welder was protected by an outfit over his face. And while the defendant, employer, had goggles on hand for the use of plaintiff, the latter did not know this or that he was supposed to wear goggles. Consequently, plaintiff proceeded to assist the welder without any protection for his eyes whatever.

After working one day and a part of the next, the plaintiff's eyes became swollen and red. He sought medical attention, received treatment, and returned to work the following day. After he had worked several hours, still, apparently with his eyes unprotected, someone told him to put on goggles.

Plaintiff complied with this, and continued to wear goggles during the remainder of his employment. But, it seems, this was too late to prevent the serious and permanent impairment of plaintiff's vision which resulted from his working with the machine without proper eye protection.

In due time plaintiff brought the instant action for damages. This action was based upon the ground that he was an inxperienced employe, in respect to the danger in working with an electric welding machine without proper protection to his eyes; that he was directed to perform this work without being warned in any way as to how to protect himself.

The trial court submitted the question of whether the defendant had, under the evidence, furnished the plaintiff with reasonably safe appliances and a reasonably safe place to work, to a jury. The latter answered this question, in effect, "NO," and gave plaintiff a verdict for $11,000. From judgment on this, the defendant appealed, and the higher court in reviewing the record, among the other things, said:

The Record Reviewed

"It appears, from what has been said, that the theory upon which (plaintiff) sought compensation for his injury is that he was an inexperienced servant, unaware of the danger of his employment, and that he was put in a dangerous employment without warning and without being supplied with goggles or other protection."

"The testimony was to the effect that specially prepared goggles were usually furnished by the operators of electric welding machines to the employes assisting the welder; but (plaintiff) was unaware of that fact, and was ignorant of the danger incident to the employment about such machines without this protection."

Then for the defense:

"It is insisted that (plaintiff) was aware of this danger, and would have been supplied with goggles had he asked for them. He admitted that an acetylene torch had been used in welding in his blacksmith shop, but,—testified that he was not the user of the torch—, which was a small one."

The court next turned to a review of the expert testimony relative to the difference between acetylene torches and electric arcs in welding operations. This tended to show that helpers on electric welders were usually provided with goggles containing arc-proof lens, while one using an acetylene torch would be protected with only colored lens. Then in stating its conclusions on the whole case, and in affirming the judgment, the court reasoned:

"The master does not insure the servant's safety, and has discharged his duty when he has used ordinary care to furnish the servant a reasonably safe place in which to work and reasonably safe appliances with which to work, while the servant himself exercises ordinary care for his own safety."

"Here, the testimony supported the finding (of the jury) that the place in which the servant (plaintiff) was required to perform his duties was rendered unsafe because the servant had not been furnished goggles or other protection which would have made his work reasonably safe. (We) are unable to say that the verdict is excessive,—the judgment must be affirmed, and it is so ordered." (142 S.W. 2d 42)

The foregoing case was carefully reasoned by the court and the holding announced is in accord with the great weight of authority on the question involved. This authority taking the position that it is the duty of an industrial employer to furnish his employes safe appliances and a safe place in which to use them.

Conclusion

Of course, each case of this kind must necessarily be decided upon its particular facts and circumstances, so that the subject cannot be covered by the statement of any hard and fast rule. But, usually, the question of blame will be one of fact for a jury, and the latter's finding thereon will rarely be disturbed if grounded upon competent evidence.

So in this case. While the judgment was large, the plaintiff's injury was serious and permanent, so the jury's verdict was allowed to stand. And, as an example of the liability possibilities in overlooking the protection of employes in this particular field of electrical work, the case reviewed is of force and value.

"I don't think we'll have to look further—This looks like it might be the leak!"

It is not often that a man is privileged to carry on, continuously, with a single firm for a period of 73 yr. That is well above the time alloted to most men for their sojourn on earth, yet here is an account of a man who has been an engineer with one company for that length of time. And now, at 87, he is still on the job, at seven a.m. every day

On The Job 73 Years

IN THE southern part of Indiana, not far above the Mason-Dixon Line on U.S. road's 31-50, you will find the city of Seymour, Indiana, the home of the Seymour Woolen Mills, manufacturers of the famous Lady Seymour all wool blankets and sport flannels. This company was founded in 1866 for the manufacture of woolens and yarns.

In the power plant of this company, you will find George M. Heiwig, Sr., Chief Engineer, who is now rounding out his 73 yr. of continuous employment with the above company, and has in his time as an engineer, seen many improvements in the power plant field.

The first engine that he had charge of was an Owen-Lane-Dyer slide valve of 25 hp. Mr. Heiwig was brought up in the field of engineering by the college of hard knocks and association with his fellowmen in his field of endeavor. In his younger days, he had to be a machinist, boiler-maker, pipe fitter, mill-wright and what not. When he had a break-down, it was up to him to make his repairs and get the wheels rolling again, or he had a bad name among his associates.

It is very interesting to hear him tell some of the experiences that he has had, such as going to some mill to repair a boiler, set a valve on an engine, see why a pump would not pump, bore out a cylinder and fit new piston and rings. You could not get supplies as you do today. Packing of flax, you braided yourself and boiled in tallows if for steam. He can tell of engines with slide bars of wood, crank shaft of cast iron, when an engine was set on logs for a foundation, later when they would take slabs of stone to set engines upon. He can recall when boring an engine cylinder, the boring bar was turned by hand and you could not stop until the tool had cleared the cylinder and was in the counter bore, lest you had a mark in the cylinder.

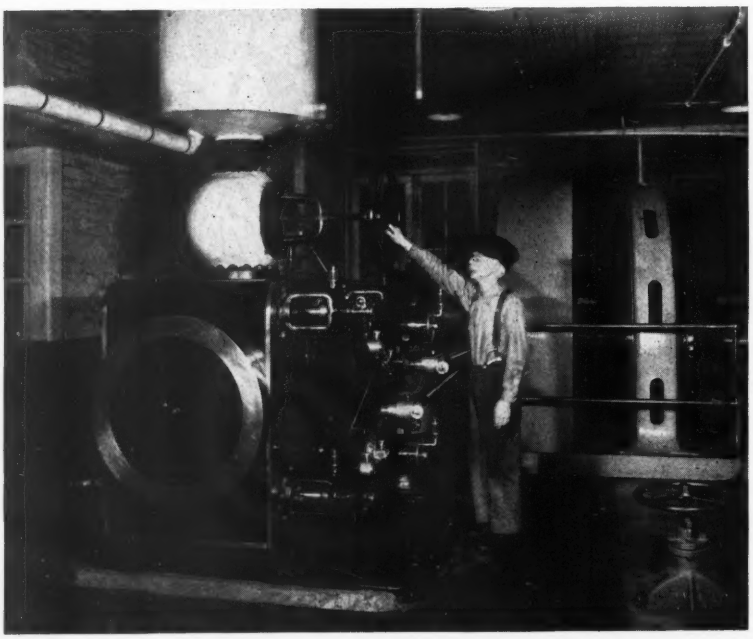


Fig. 1. George Heiwig, Sr., at the throttle of his Corliss

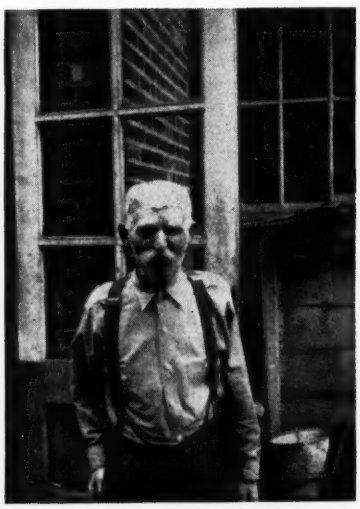


Fig. 2. George Heiwig

The fuel used was wood and for cylinder lubricator you used tallow. In 1881 he erected and operated his first Corliss Engine, which was a 18 by 42 in. Atlas and has in his possession today the local newspaper of that time telling about the large fly wheel on this engine. He has always even to this day, taken great pride in the equipment placed in his trust. You will always find it clean and running smoothly.

He operated his first electrical equipment in 1904, which consisted of a 75-kw., d.c. generator and four 15 hp., d.c. motors as well as a large number of lights in the mill. Also at this time, he placed in operation another Corliss Engine, 20 by 42 in., which also was an Atlas, replacing the engine that was installed in 1881, which was sold to a local manufacturing company, who also got many years of use from it. In 1933 he placed in operation a Chuse-Non Releasing Corliss, size 25 by 32 in. with a 400-kw. direct connected generator, which unit is furnishing power for the mill today.

June, the 23rd day of this year, he will have reached his 87th birthday and appears to be in the best of health. He is on the job every morning at 7 A.M., ready for what the day may bring.

PRACTICAL HINTS AND KINKS

Repairing of Concrete Floors

EVERY ONCE in a while the problem of repairing concrete floors comes up for the engineer to solve. The question is asked, "What can be done with a bad crack that leaks water? How can a repair be made that will be both substantial and waterproof?"

Unless there is considerable vibration on the floor, it is a simple matter to waterproof the floor by first cutting out the crack into a V-shaped groove to a depth of at least 2 in. Sweep water over the newly cut concrete removing all loose particles of cement and sand. Prepare a stiff and waterproof mortar by mixing together 1 part portland cement and 2 parts clean, sharp sand, and wet down with a solution of 1 part liquid waterproofing and 8 parts of water. Immediately before filling the grooves with this new mortar, brush over the clean, damp surfaces a slush or bonding coat made by stirring into a solution of 1 part liquid waterproofing and 3 parts water enough portland cement to form a thick, creamy cold water paint. While this cement wash is still damp, apply the new mortar and trowel it to a smooth finish.

In a similar way the ruts and holes in a concrete floor can be cut out to a depth of 1½ in. below the finished floor and new patches applied, which will adhere to the underlying concrete and which will be waterproof, hard and dustproof. Patches of this type harden over night so that the repairs can be made on Saturday afternoon and Sunday or during a similar shut-down.

Line Shafting

By W. F. Schaphorst

THIS CHART eliminates computations and enables one quickly to determine the diameter of rolled or turned shafts for transmitting a certain amount of power at a given r.p.m., knowing the nature of the loading on the shaft.

EXAMPLE: 100 hp. is to be transmitted at 500 r.p.m. Turned steel shafting is to be used with pulleys close to hangers. What should be the diameter of the shaft?

ANSWER: The dotted lines drawn across the chart show how the problem is solved. Run a straight line through the 500 in column A, and the 100 in column B, and locate the intersection with column C. Then from that point of intersection run over to the point in column E corresponding with "turned shafting" showing the pulleys close to the hangers or bearings. The intersection with column D shows that the shaft diameter should be 2.62 or 2⅝ in.

The sketches at the right of column E shows visually the nature of the loading. Thus, at the top we have a plain shaft running through two bearings without any pulleys on it whatsoever. In that case the shaft it subjected to torsional stresses only and not to banding stresses. The third and fourth diagrams from the top show pulleys close to the bearings. The two bottom diagrams show pulleys scattered all along the shaft in which case conditions are most severe, consequently the shaft must be largest in diameter.

It will be noted in each case that smaller cold rolled shafting may be used than turned shafting.

The range of this chart is great enough to take care of most ordinary conditions. The r.p.m., column A, range all the way from 50 to 3000. Column B includes horsepower from 1 to 4000. Column D shows shaft diameters from 1 to 10 inuclusive and column E includes practically every loading condition.

This chart is applicable to examples having bearings not more than 8 ft. apart.

Cutting a Square Key in a Lathe

By Arthur F. Churchill

Can you cut a square key in a lathe? It's simple! Take a four jaw chuck and insert the key stock in the chuck at right angles to the axis of rotation. Instead of rotating longitudinally, the stock will rotate laterally giving access to the tool its entire length. Each side and the taper can be turned up nicely with just one setting for each.

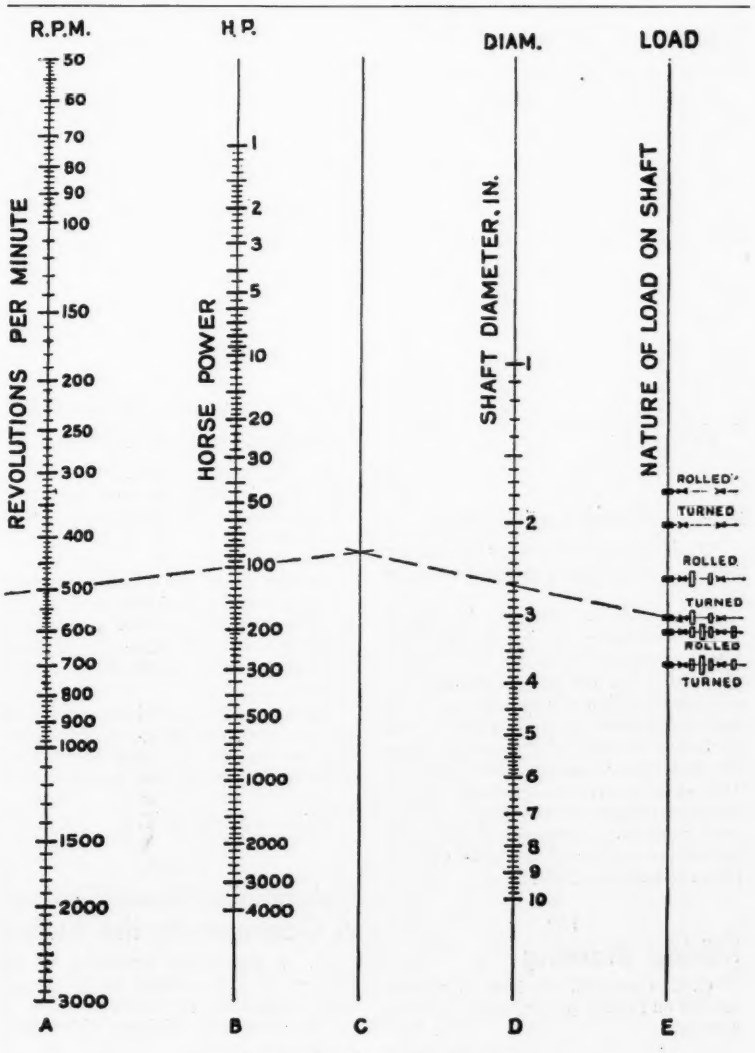


Chart for Calculating Line Shafting

Questions And Answers

119
Aftercooler Corrosion

Q. Several years ago we installed, in one of our plants, an aftercooler in an air compressor line. Just recently we discovered that not only had the tube bundle been almost completely destroyed, but the shell, too, had been attacked—and badly corroded. There are many possible explanations of this phenomena, but which is the correct one? The plant contains 3-wire, d.c. generators. (Further details not available at this time.)

We have engaged a specialist in electrolysis and hope to have the correct answer before long, but here is an opportunity for readers to test out their knowledge of the subject. We will send in a brief of the specialist's report in due time.

St. Louis, Mo. L. A. H.

120
Overfire Air

Q. Our boilers are fired by chain grate stokers and the furnaces are equipped with steam jet air ejectors for supplying overfire air. The question arises as to whether it is desirable to have the steam jets operating at all times or just at times when the stack has a tendency to smoke.

Chicago, Ill. P. S. S.

121
Atmospheric Condenser

Q. Under what weather conditions will an atmospheric condenser be most effective?

Detroit, Mich. L. W. H.

A. Inasmuch as an atmospheric condenser depends on the evaporation of water from the outside surface for cooling, its action will be most effective during dry weather. When the humidity is low the rate of evaporation from the wet surface to the air is greater. The capacity is also greater during windy weather for the wind quickly carries away the saturated air from the immediate surface of the coils and replaces it with dryer air.

122
Mildew Proofing

Q. Can you tell me how to prevent mildew on fabrics, particularly on shower curtains? E. N.

A. Maintenance engineers are called on to perform a host of tasks and while we may be convinced that we are being imposed upon, nevertheless try to do our best. Engineers certainly should not take over all the duties of institution housekeepers, but this particular problem falls in the lap of the engineer often. Sometime ago I had the same problem and solved it successfully with the help of a chemical engineer, as follows:

When the material comes from the laundry, make up two solutions: the first by dissolving from 1 to 2 lb. (depending on the quality) of flake soap in 1 gal. of water; the second by dissolving 3 oz. of cadmium chloride crystals in 1 gal. of water. About 15 gal. of each solution is needed for a shower curtain.

First submerge the curtain in the soap solution and keep just below the boiling point for 20 min. Then remove and wring dry. Now soak the cloth in the second solution and heat for 30 min. Remove, wring (but do not rinse) and hang out to dry where the air circulates freely. To avoid stains use a fabric clothes line.

This treatment is not injurious to colors and is quite durable, usually lasting until the curtain again requires laundering.

Milwaukee, Wis. P. C. Ziemke.

A. 98
What Happens When the Condensate Pump Stops

A. In regard to H. B. K's question (No. 98), in Feb. issue of P. P. E. I would like to say he is right. And my answer is based on actual experience.

In our plant we have practically the same set-up as he describes, and on several occasions our condensate pump has stopped, once for at least 30 minutes with no ill effects to the turbines.

However this should be avoided as running non-condensing causes excessive heating of the condenser which is bad on the tubes and packing.

Carl E. Smith

Winston-Salem, N. C.

A. 104
Determining Power Costs—A Comment by the Author

A. I was much interested in the answers to my question in the March issue regarding the determination of the Rankine cycle efficiency of turbines. I had not intended to comment further on it since it had already been answered satisfactorily, but in the June issue you have published three answers, which, to my mind, leaves a turbine operator, unfamiliar with methods of calculating turbine performance, in somewhat of a quandary as to the correct method to pursue, so I wish to add a few words on the subject. I want to discuss the problem in such a manner as to leave no doubt in the minds of those who may be interested in the subject as to the correct procedure.

The Rankine efficiency, or what is generally referred to as the Rankine ratio, is not dependent on the thermal properties of the steam.. For example, two turbines may have the same Rankine efficiency and operate under entirely different steam conditions. Say one turbine absorbs into work 100 B.t.u. per lb. steam, and the other absorbs into work 200 B.t.u. per lb. steam, yet have the same efficiency. Accordingly, when we think of a turbine in terms of its Rankine efficiency, we are concerned with a ratio and not a thermal property.

The Rankine efficiency is therefore the ratio of the theoretical water rate to the actual water rate. It is the ratio of the heat in the steam actually converted into work to the heat in the steam available for work between the same terminal pressures.

By referring to the Mollier diagram we find that for 250 lb. gage, 150 deg. superheat (265 lb. absolute on the diagram), the heat content (Enthalpy) is approximately 1292 B.t.u. per lb. steam. Now, by projecting vertically downward from this point to the 2.5 in. absolute back pressure line, (27.5 in. vacuum) we find the heat content of the steam at exhaust to be approximately 914 B.t.u. per lb. From which the available heat in the steam = 1292 — 914 = 378 B.t.u. per lb. In this case the steam is expanded adiabatically and we have a turbine with an efficiency of 100 per cent. The theoretical water rate is then 3413 ÷ 378 = 9.03 lb. per kw-hr. Since the guaranteed water rate is given as 13 lb. per kw-hr., the Rankine efficiency = 9.03 ÷ 13 = 0.697 or 69.7 per cent.

At 26 in. vacuum, assuming no losses as above, the heat in the steam at exhaust is approximately 939 B.t.u. per lb. Assuming the efficiency to remain the same, at 69.7 per cent, the water rate at 26 in. vacuum = 3413 ÷ (0.697 × 353) = 13.79 lb. per hr. (1292 — 939 = 353). The water rate at 26 in. vacuum is (13.79 × 100) ÷ 13 = 106 per cent of that at 27.5 in. vacuum.

Discussing the three answers, not from a critical viewpoint, but from a standpoint of clarification, we observe the following:

Mr. Gabriel gives equations for thermal efficiency and not Rankine efficiency. Engineers and operators are not generally interested in the thermal efficiency of a particular piece of equipment in a plant, but are highly interested in the thermal efficiency of the plant as a whole, which must include every heat consuming piece of ap-

paratus from the coal pile to the switchboard.

Mr. Gabriel also confuses "Specific Heat" with "Enthalpy". As a matter of interest the mean specific heat of superheated steam is derived as follows:

$$C_{pm} = \frac{H_{sup} - H_{sat}}{t_{sup} - t_{sat}}$$

C_{pm} = mean specific heat of superheated steam.
H_{sup} = enthalpy, in B.t.u. per lb. of the superheated steam.
H_{sat} = enthalpy, in B.t.u. per lb. of the saturated steam at the given pressure.
t_{sup} = temperature in degree F. of the superheated steam.
t_{sat} = temperature in degrees F. of the saturated steam at the given pressure.

Mr. Julsrud distinguishes between Rankine efficiency and Rankine ratio, which again confuses an operating cycle with thermal properties. He gives, however, correctly, the Rankine efficiency, or Rankine ratio, whichever you choose to call it, in the second column of his answer.

Mr. Fox outlines the correct theory, but his values are considerably in error. For example, the absolute pressure at 27.5 in. vacuum is approximately 1.23 lb. and not 2.49 lb. At 1.23 lb. absolute back pressure, adiabatic expansion, the heat in the steam is about 914 B.t.u. per lb. 1292 — 914 = 378 B.t.u. as before. He divides the equivalent B.t.u. per horsepower, (2545) by lb. water per kw-hr. This should be 3413 ÷ 13 = 262.5 B.t.u. per lb. steam converted into work. From which the Rankine efficiency = 262.5 ÷ 378 = 0.695, which checks my value arrived at by another method.

In conclusion, it may be stated that unless the actual water rate is given or assumed, the Rankine efficiency cannot be derived from the Mollier diagram.

Raleigh, N. C. F. C. DeWeese

A. 109
Reducing Noise in Water Heater

A. A small device that produces no noise while using steam to heat water in the rinsing basin of a soft drink fountain, might be made to work in P. G.'s water heater if made on a larger scale.

It consists of a ⅛ in. to ½ in. bell reducer with several holes about ⅜ in. in size, drilled equal distances apart about midway from the ends. A ⅛ in. by 2 in. pipe nipple is screwed into the inside of bell reducer from the ½ in. end, and a ½ in. by 4 in. pipe nipple is screwed into large end of bell reducer over the ⅛ in. by 2 in. pipe nipple. A ⅛ in. pipe is screwed into the ⅛ in. end of bell reducer and leads to the regulating valve and steam supply.

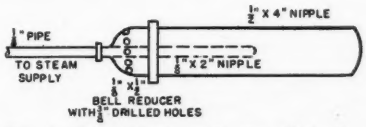


Fig. 1. Enlarged view of noise eliminating device used in soft drink stand rinsing basin

The jet-like action of the steam issuing from the ⅛ in. nipple inside of the ½ in. nipple, draws water through the drilled holes in bell reducer with such force as to give a more intimate contact and thorough mixing of the water with the steam. This prevents the formation of steam bubbles that collapse upon coming in contact with the water, which is the cause of the irritating noise in P. G.'s water heater. Increased circulation and heating of the water should be obtained if proper sized fittings are used in making-up the device, of which several could be placed equal distances apart in the 2 in. steam line in side of heater, as showing in Fig. 2.

The two rough sketches show, Fig. 1, enlarged view of device in soft drink fountain, and Fig. 2, the proposed method of installation in P. G.'s large water heater. In all probability, the trial and error method may have to be resorted to, in order to obtain proper results, however, some consideration should be given to their size to allow for proper volume of steam as well as to the proper location deemed best to give good circulation and speedy heating of water.

Paul F. Dickens, Sr.

Quanah, Texas.

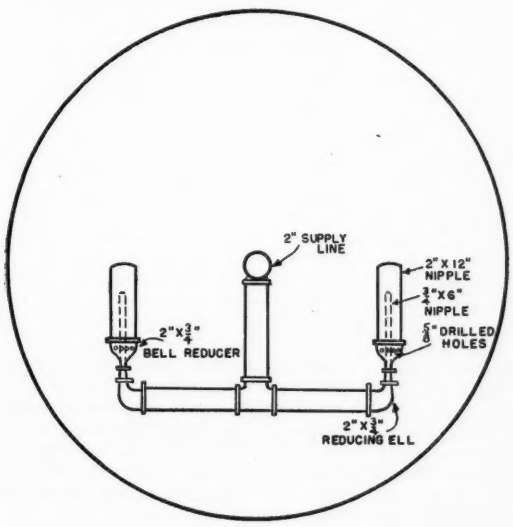


Fig. 2. End view of fittings and proposed installation of noise eliminating device in large water heater

A. 113
Water Column Valves—Our Answer Was Wrong

A. On page 94 of the April issue you answered a question sent in by E. P. Z. of Chicago regarding the location of water column valves. Your answer can hardly be considered correct and I wonder where, in the A.S.M.E. code, you obtained your information. The A.S.M.E. Boiler Code (1937) Par. P. 293 reads as follows: (Page 109)

"When shut-offs are used on the connections to a water column, they shall be either outside-screw-and yoke type gate valves, lever lifting type gate valves or stop cocks with levers permanently fastened thereto and marked in line with their passage or of such other through blow construction as to prevent stoppage by deposits of sediment and to indicate by the position of the operating mechanism whether it is in open or closed position; and such valves or cocks shall be locked or sealed open. Where stop cocks are used they shall be of a type with the plug held in place by a guard or gland."

Practically all state boiler codes are based on the A.S.M.E. Boiler Code (Even Mass. is using a huge portion of the A.S.M.E. Code but the paragraph numbers are different). It is not contrary to the state laws and codes to use shutoff valves in water column connecting pipes if Par. P. 293 is complied with.

As regards marine boilers please refer to Page 92—Par. C-(f) of the Fifty-first Supplement to General Rules and Regulations, Jan. 1, 1935 AMENDED RULES 1 and 11 General Rules and Regulations—U. S. Dept. of Commerce—Bureau of Navigation and Steamboat Inspection.

Above paragraph reads as follows: (C-15-11 (f)

"When water columns are provided, they shall be fitted to the heads or shells of boilers or drums with shut-off valves attached directly to the boilers or drums, or if necessary, connected thereto by an approved distance piece both at the top and bottom of the water columns. Water column piping shall not be fitted inside the uptake, the smoke box, or the casing."

Frank W. Larkworthy.

Chicago, Ill.

Editors Note. We have checked Mr. Larkworthy's reference and find that he is correct. This question was answered for us by an outside contributor and we have asked him to explain where he got his information. Further comment will be presented in subsequent issues.

LETTERS AND COMMENTS

Matt Pawlowski Rebutts

IN REGARD to my article of February 1941, in POWER PLANT ENGINEERING, I regret that Messrs. Williams and Churchill have missed its theme. Primarily, to answer Mr. Williams, all that is necessary is to rewrite his article, substituting other names and lower ages. (Possible, and authentic upon request.) You can tell me interesting things about some of the oldsters of your acquaintance. I can tell you about some of the boy wonders that I'm associated with, and we would be kicking the gong around indefinitely. Also, to better inform my dear friend from Wingdale about license law, the regulations that I'm referring to, Sam, would be based on the same principles as the U. S. Steamboat Inspection Bureau uses for licensing marine engineers. Or the manner in which the F. C. C. and the C. A. A. regulate men and equipment. You'll agree with me, Mr. Williams, that these government agencies have made remarkable achievements during their existence. It was through the C. A. A. that the major airlines were able to round out a better than a year record without any accident. Remember, Sam, your daily paper had an account of it. I'll have to leave you through a paragraph or two in order to "vindicate" myself in re to Mr. Churchill's "indictments."

Arthur, what I meant about that "available literature" is that some years back the engineering profession was on "the lag." The progress in modernization of power plants was a skeptism. Thus, there was no available literature about something that did not exist. However, today we have modern engineering and I'll admit that literature about it is available to young and old. But the point I want to put over is, that after the young man goes through it he wants to put himself on a par with his contemporary. (If he understands what he reads and can apply the information he so accumulates why shouldn't he?) Catch on, Arthur? You ask, "Why don't executives and boards of directors snatch up the young men?" That is exactly what they are doing. If you'll watch the want ads in your local newspapers you will, nine out of ten times, see ads reading something like this: WANTED: ENGINEER, YOUNG, 25 TO 35, TO TAKE FULL CHARGE. MUST BE AGGRESSIVE. HIGH SCHOOL EDUCATION, ETC. Check that, Arthur, and see if I'm not right. Whenever an Old Timer leaves a plant he is usually replaced by a young man. And it seems to me that the only reason a firm keeps an Old Timer is because they are morally obligated. That practice does not only exist in the engineering field but everywhere. Your own government is striving to pass a bill rejecting men over 28 years of age for conscription. Reason: and to put it colloquially: "you can't teach an old dog new tricks." Men all over the country (according to the newspapers) are complaining that they cannot get work because they are over 45. It is only because of the National Defense Program that a portion of them were rehired. But let me make a prediction that when all this fracas blows over, the young boys who have "invaded" the industrial field will be held, and the oldsters will be given the "pink slip" in their pay envelopes. I do not make this possible by the stroke of my pen, or cannot be held liable because I am young. But it is the powers that be who make it so. Everyday and in everyway it is "The Accent on Youth." To quote a part of your letter "that each man must have the same latent qualities," that is absolutely true. Nevertheless, can you or I do anything about it if he hasn't? Yes, siree, my boy, there are plenty who haven't and are still working at it. Where? In those two by four outfits where they save in the low wage scale they maintain, and then turn around and lose it out the stack in B.t.u.'s.

To sum it all up brings the writer back to license laws and Sam Williams. Now then, if we have federal regulations which would make the "imposters" toe the line, that would eliminate possible disaster and bring the engineering profession to a standard where it rightfully belongs. The writer has been in the merchant marine for about 5 yr. and he has yet to hear that politics have plagued that branch of engineering. However, I cannot say the same about the present setup in the stationary field. You say you do not believe in any organization interfering with the honorable field of engineering. Would you say the A.S.M.E. proved itself detrimental in the conservation of fuel and property? Mr. Williams, I strongly believe that Uncle Sam would make a good "Chief Engineer."

MATTHEW W. PAWLOWSKI.
Philadelphia, Pa.

Two Letters from Arthur Parker

I WAS more pleased than I can say with the replies to my water problem. I herewith express my thanks to each and every one who sent in solutions and suggestions. Obviously, owing to the new 6 in. main now in process of installation, it will not be necessary to avail myself of any of the solutions already sent in.

There will remain, however, the problem of restricted flow, even with the new main delivering an ample supply just outside our walls. I am making every effort to have such corrections made inside the building as are possible and practicable from a standpoint of labor, time and material.

Just inside the walls, two 2 in. branches take off from the 2½ in. main. One of them serves the thirteen flushometers and the other serves all other house demands for both hot and cold water. Many times a day the 2 in. house service line will have its capacity exceeded from two to three times. Obviously the wisest procedure would be to run a new laundry supply line and an additional line to the hot water tank. This is entirely out of the question, it being a matter of going through several stone and brick partition walls and at least a 75 ft. run. So here is what I am trying to get done.

I want the 6 in. line brought in to the house, continuing on from the hydrant shut off vault just outside the building where branches to five hydrants take off, and connected up so that each 2 in. line will take off from the 6 in. main. That's all I can possibly get done and I am afraid there is going to be disappointment when conditions are found to be not entirely corrected. But can I do any better?

I plan to eliminate the two large water filters as they were installed before the town had a chlorinator and are to a certain extent unnecessary now. They need recharging which costs around $500 for material and labor. Hate to junk them, but I don't know where they could be sold. Come to think of it, maybe Pulverizer Pete could use one of them for his Saturday night ablutions. He could fill it with the bucket our "docs" won't be using (I hope they won't) after the new main is in. I'll say Pete knows his nurses. The "chaser" at 2 A. M. sure rang the bell. Where will I send the bath tub Pete, if, when, and as they let me take it out?

It seems to me that some might regard the publicity accorded Peterboro Hospital and its inadequate water supply as not entirely desirable. I would like to explain how it happened that such a condition existed. In addition to its famed MacDowell Colony, Peterboro is the home of many beautiful estates. In 1922 or thereabouts, the owner of one of them in grief over the loss of a loved one, gave it to the community for a hospital. There is a splendid brick building and 90 acres, more or less, of land, most of it heavily covered with pine and rock maple, much of it old growth. Public spirited citizens chipped in with $250,000; much has been spent since that time; and we now have one of the finest equipped and staffed small hospitals in the country.

No one, however, thought of the terrific handicap the inadequate water supply would grow to be (a water supply installed with the building of the original estate) with the future and expected natural growth of the hospital.

That's how it happens so many of my kindly brother engineers are putting their shoulders to the wheel to help out the erstwhile "Hero" Arthur H. Parker.

ARTHUR H. PARKER.

It has always been very pleasing to me to note the consistent impartiality shown by POWER PLANT ENGINEERING between the problems of the little fellow and those of the man in the great central station. I am sure that my recent problem (Hospital Water Supply, Problem 15) has received the same courteous editorial attention and has elicited as many kindly and informative replies as it would have received had it been some grave and weighty matter involving the water supply of a great city. And this courtesy and co-operation I certainly do appreciate.

I'd like to tell you about our fire protection. When I arrived upon the scene in 1930, subsequent to the departure of a previous alcoholic incumbent, I was disconcerted and tremendously handicapped to discover the known existence of not one single blueprint of pipe or wire. Original layouts had been discontinued, new ones installed, and no record made of any change. I could not have lasted a week if there had been no ground work of 20 yr. experience, long hours of investigation and study—and the privilege of many years' subscription to a splendid engineer's magazine.

Shortly after taking over, I put on a fire drill. And what a drill! From the top of a ladder to lend realism, I shouted to the man at the hydrant to "Turn her on" bracing myself for the expected surge and thrust of torrents of water. Eventually, and at long last, after much impatience and cussing, there emerged from the nozzle a squirt so feeble as to be little more than a heavy dew! Subsequent to that disconcerting fizzle and disappointment, I looked up the fire chief and through him got to the trustees. Before long, things were changed. The fine, underground cement tank, with its thousands of gallons of water, perpetually available to the town pumper, which resulted is something I like to think of as a sort of memorial to my interest and efforts.

ARTHUR H. PARKER.
Peterboro, N. H.

He Liked Mingle's Article

MR. MINGLE deserves considerable credit for his analysis on chimney design. He proves that a little fresh thought will season an old subject. As for the purely academic question as to why a chimney functions; i.e., pulling or pushing the gases, I do not think that he should be picked up on that. To me, the question is a reminder of the children's version of an Oriental's conception of the Occidental "go-devil"; "No pushee—no pullee—but go like hellee."

Perhaps in the future you can persuade Mr. Mingle to give us the analysis of an actual sample of his work, and the results obtained.

SAM WILLIAMS
Wingdale, N. Y.

Further Comment on Problem 15

I WISH to express my appreciation for the consideration given my answer to Problem No. 15 in your March issue. There is however a point I hesitated to make (not wishing to be critical), and that Mr. Parker has stated again in his letter appearing in your May issue, that it is necessary to alter the building's piping because the 2½ in. supply line is immediately cut down to 2 in. branches. He states branches in the plural, meaning two or more, making it necessary to comment farther.

Now that the cross sectional area of two 2 in. pipes is 6.2832 in., and that of one 2½ in. pipe is 4.9 plus in., we find that his building's capacity exceeds that of his supply line at this point by 1.3 plus in., so his bottleneck is not here as stated by Mr. Parker.

Farther consideration of the problem is in order now that he is to have a new 6 in. supply line. Assuming his various branches throughout the building diminishes in size in proper proportion, and as per original problem the water supply was adequate except for the laundry's demand, which was supplied through a 1½ in. line. Then we find that a 1½ in. line has a cross sectional area of 1.76 plus in. Now if we check this with the 1.3 plus in. surplus, the two 2 in. lines have over the one 2½ in. line as stated above. We find a slight difference of .33 in. which I feel would be adequately compensated for by an increase of pressure when the new 6 in. line is installed.

GLEN BROWNING
Columbus, Ohio.

HINTS AND KINKS

A Non-Caustic Cleaning Solution

By Paul C. Ziemke

EVERY LARGE organization employing heavy machinery in its business is confronted with the problem of thoroughly cleaning machinery parts of grease, oil and grime prior to making repairs and re-assembling them.

While caustic solutions have long served to accomplish this purpose a new and much better solvent that has none of the objectionable features of the evil smelling, corrosive, fog producing proclivities of heated caustics is now available in trichlorethylene. This new solvent requires replacement only at rare intervals to compensate for leakage and loss by being carried off in recesses in the cleaned parts. It boils at the low temperature of 188 deg. F. and at that temperature throws off a dense vapor that rises and envelops the parts that require cleaning. Since the boiling point of oil is far above 188 deg. this vapor when coming in contact with the oil and grease coating on the dirty parts condenses and flows back into the tank. It is this action, repeated over and over, that attacks and dissolves the grease and carries it to the tank's bottom.

The tank requires no cover or vent pipes as is required with caustics since the vapor is prevented from rising beyond the confines of the tank by the simple expedient of providing a cold water jacket some 35 in. up from the tank floor. As the vapor reaches this cooled zone it condenses and rises no higher but trickles down over the work placed in position for cleaning. It is this constant bathing of the parts that accomplishes a thorough cleaning rapidly and effectively.

The trichlorethylene solvent is drained out of one corner of the tank by a 15 g.p.m. single stage, electrically driven, centrifugal pump the discharge of which is directed into a sheet metal box. In these boxes are located four wire screen partitions which support a like number of sections of celotex through which the solvent filters and is "scrubbed" before returning to the cleaning tank. The celotex requires renewing about once per week when the unit is in constant use.

Our tank measuring 84 by 30 in., with a depth of 65 in. contains on an average of 25 gal. of solvent. This is heated to the boiling point (188 deg. F.) by 8—550 w., 120 v. space heaters clamped directly to the tank's bottom. These are controlled by a thermostatic, motor operated switch.

Both the "scrubbing" and the cleaning tank are constructed of ⅛ in. sheet metal reinforced at the corners with 1½ by 1½ in. angle iron. Space for the heaters and the wiring is provided by a brick foundation elevated 5 in. from the floor. The tank sides are insulated against heat losses by covering them with plates of magnesium and asbestos compound ½ in. thick held in place by jacketing fashioned from 22 gage sheet metal.

How Would You Do It?

PROBLEM 16

INTERCONNECTING THE NEUTRALS

IN TOYING with the idea of interconnecting the neutrals of his a.c. and d.c. systems as set forth in Problem 16, Our Hero, for once, seems to have hit upon an idea that wasn't entirely "cockeyed." As a matter of fact nearly all of those who took a crack at the problem agreed that the scheme was practicable provided the systems were maintained in a reasonably balanced condition. This, however, made it difficult for the Board of Judges to decide upon the winning letters.

Strangely enough, though nearly all agreed that there were conditions which had to be guarded against, very few pointed to the most serious possible cause for trouble. It was this fact that gave the first prize to R. C. Ericson of Hammond, Indiana. His particular emphasis upon the danger of direct current in the a.c. winding of the transformer easily gave his letter first place. Of course, there were other pitfalls inherent in the proposed plan, those involving the Underwriters rules for example and the possibility of excessive voltage rise above ground on the two systems, but in general, the plan would work if the direct current could be kept out of the transformer windings. The connection is likely to cause trouble only when the alternating current circuits have two or more connections to the neutral, so located that direct current will pass through the transformers when flowing between connected points. As Mr. Ericson points out, the impedance of most direct current apparatus is so high that very little alternating current would tend to flow through it but this is not true of the opposing condition. The impedance of alternating current windings on the other hand is liable to be quite low to direct current and even small direct currents in such windings can be serious. A direct current of five per cent of normal full load alternating currents is prohibitive unless it is introduced in such a way that its magnetizing effect is neutralized, as for example in a three-wire diametrically converted synchronous connecter where the direct current is introduced at the middle point of each transformer phase or where the transformers have the zig zag or interconnected star connection.

It was this recognition of the danger of direct current in the a.c. windings that gave Mr. Ericson an advantage over the other contestants.

The question of meeting the Underwriters requirements, while it has little bearing upon the more technical aspects of the problem is, nevertheless, important and it was for this reason that duplicate third prizes were awarded to Messrs. Markland and Jantz. Both of these contestants analyzed that phase of the situation with considerable merit.

Mr. Stout's second prize letter speaks for itself. It is short and clear and points to the other pitfalls in this connection in a very effective manner.

Whether Our Hero will put the plan into effect we cannot say but if he does he certainly will know from the following answers what to look for in the way of possible trouble.

First Prize Award

R. C. Ericson
Northern Indiana Public Service Co.
Hammond, Ind.

Tying the neutral of a 3-wire 110-220 v. direct current system to the neutral of a four wire three phase low voltage a.c. system would offer no difficulty whatsoever if both systems were exactly balanced and no neutral current was required by either system.

In the case of unbalanced loading an estimate of the difficulties to be encountered may be obtained by considering the following points:

a. The neutral of the alternating current system becomes the original neutral conductor in parallel with the positive and negative mains of the d.c. system in series with the loads or generators which tie these mains to the neutral. Any unbalance (neutral) current of the alternating current system will divide between these three paths in accordance with their sixty cycle impedances. Since the impedance of most of the direct current equipment would be very high to the a.c. current flow little difficulty would be expected from this source unless the unbalance on the a.c. system was large. The following types of d.c. equipment would bear watching: Sensitive D.C. control relays or equipment may develop objectionable chatter even on small amounts of a.c.; electronic devices may

PROBLEM 17

HEATING WATER FOR A LAUNDRY

Having got the low-down on his common a.c. and d.c. neutral problems Our Hero now is working on a laundry problem. Like many of his other problems, this one is not his own; it was put up to him by a friend by the name of Christenson whose plant he visited the other day. Mr. Christenson wanted Our Hero's opinion regarding the most economical method of heating water for the washroom of the laundry and linen supply plant of which he is chief engineer. At present they are using live steam washers.

The plant has two storage tanks of 18,000 gal. capacity. These are filled at night and softeners feed these tanks during the day. By night they are both empty. Now, they are contemplating the installation of another 15,000 gal. tank. They use 50 to 60 thousand gal. of water per day and estimate that about 20,000 gal. of hot water will be required.

A Schwab boiler return system is installed which keeps the boiler feed water around 250 deg. F.

What Mr. Christenson really wants to know is whether there is some arrangement available that he does not know about which would heat the water economically and perhaps instantaneously.

Write out your opinion of this problem in a letter of not over 1000 words and send it to the Contest Editor by July 25. A first prize of $15 will be awarded for the best letter, a second prize of $10, and a third prize of $5. Entries should be addressed to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago, Ill.

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develop undesirable hum or even amplify the effects of very small amounts of a.c.; any communication equipment supplied from the d.c. system might become noisy. Generators, motors, heating equipment, etc., should suffer no ill effects from the small amount of A.C. current that would flow in them due to any reasonable unbalance on the A.C. system.

b. The neutral for the d.c. system becomes the original a.c. system neutral wire in parallel with the three phase wires of the a.c. system in series with their respective transformers. Any a.c. load connected from phase wire to neutral is of course effectively in parallel with the transformer winding feeding that phase. Now any unbalance (neutral) current in the d.c. system will divide between these paths in accordance with their d.c. resistance.

If the direct current in the transformer windings becomes appreciable, i.e., a fair percentage of the normal a.c. exciting current value, poor a.c. wave form may result. Also the transformers may draw excessive exciting current with resulting increase in losses and heating.

Appreciable quantities of d.c. current in a.c. motor windings will have a similar effect.

In some types of a.c. control equipment the presence of small amounts of d.c. current gives the same effect as strong residual magnetism and may even cause serious difficulties in operation.

Heating, illuminating and similar equipment should give no difficulties unless transformer equipment is involved.

One way to mitigate this type of trouble would be to have the d.c. resistance of the neutral wire very low in comparison with the resistance of the phase wire paths. Also of course try to keep the D.C. load reasonably balanced.

Not knowing what type of load is being served by either system only general statements can be made but neutrals of the two systems can certainly be tied if the neutral lead wire is of low impedance as compared to the other possible paths of neutral current flow and in addition the loads on both systems are kept within a reasonable degree of balance.

Second Prize Award

J. Bruce Stout
Oklahoma Gas and Electric Co.
Oklahoma City, Okla.

The "else" of Problem 16 concerning Our Hero's idea of interconnecting the neutral of the a.c. system with that of the d.c. system is simply that the idea is feasible provided each neutral is separately grounded, and the interconnecting wires are not overloaded in current.

When the neutral of each system is equipped with a substantial ground connection directly as the power source so as to stabilize the voltage of each system, then it is a simple matter to provide interconnecting wires which are capable of safely carrying the maximum current that may be possible to have. This current should be calculated in order to determine appropriate sizes of interconnecting conductors.

Comparison of Code Requirements

	1937 Code	1940 Code
Direct Current—neutral ground.	not required, Art. 2532.	required, Art. 2513.
Location of above	Supply Station only, Art. 2532.	Supply Station only, Art. 2522.
Alternating Current, neutral ground.	Required if maximum voltage to ground does not exceed 150 v. Grounding recommended for 150-300 v. to ground.	Required if maximum voltage to ground does not exceed 150 v. Grounding recommended for 150-300 v. to ground. Higher voltage circuits may be grounded.
Location of above	Each individual service or transformer, Art. 2533.	Each individual service or transformer, Art. 2523.
Conductors of Different Systems	May not occupy the same raceway, etc. Art. 3013.	May occupy the same raceway for light and power for 600 v. or less, Art. 3013.

The hidden pitfalls in the proposed arrangement consist of: first, excessive voltage rises above ground on the two systems, and, second, of excess current in the interconnecting wires. The former may be eliminated by grounding the separate neutrals, and the latter eliminated by providing conductors of suitable size, as above described.

Without these precautions, which are prescribed by the underwriters, the unbalanced load in either the a.c. or d.c., or both systems, causes the neutral-to-ground voltage to shift from zero and rise to a value governed by the degree of unbalance. This rise in neutral-to-ground voltage is then added to the normal line-to-ground voltages of the conductors of both power system, thereby increasing the insulation stress of these conductors. Obviously, if the degree of load unbalance becomes very large, the increased line-to-ground voltages would probably cause insulation failures in the line conductors.

Third Prize Award

A. R. Markland
Altoona, Pa.

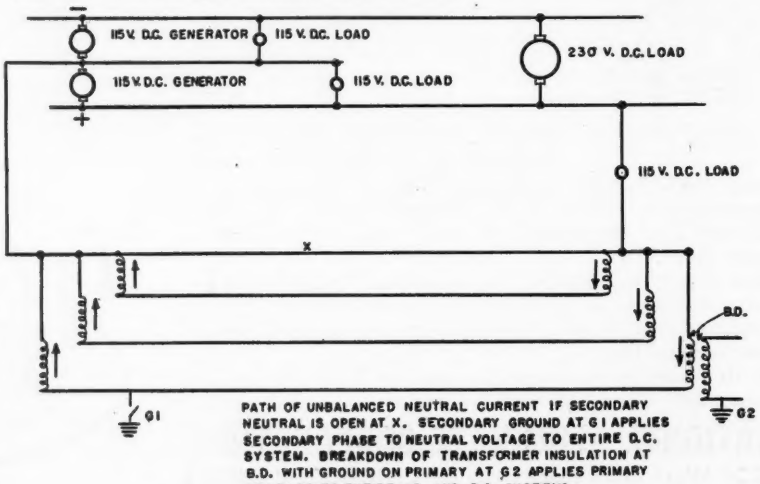
The diagram as shown with the question does not show any ground connections or voltage between wires, therefore, the following points should be considered on the basis of National Electric Code requirements:

Assuming that the voltage between phases is 220 and the 1940 code is enforced, it would be impossible to have a direct current system neutral grounded at the supply station only, common with an alternating current neutral which must be grounded at each transformer bank and service. This would apply under the 1937 code also on account of grounds being required at each transformer bank.

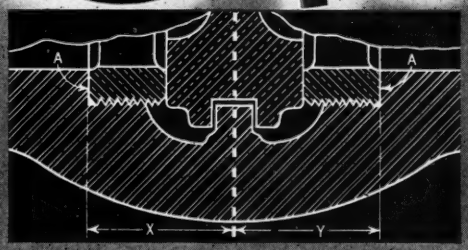
On the basis of the 1937 code, conductors of different systems may not occupy the same raceway, therefore, one conductor should not be made common to two systems. Aside from the code requirements, if the neutral were made common, the following operating difficulties might occur:

Assuming that the system is not grounded, a breakdown of any transformer insulation might subject the direct current and alternating current systems to primary voltage to ground. Also a ground on one of the a.c. secondary mains would apply secondary phase to neutral voltage between the entire d.c. system and ground.

If the neutral were interrupted between transformers any direct neutral current would flow through the secondaries of two or more banks of transformers, thus reducing their reactance and tending to overload them. These conditions are shown on the attached sketch.


115 V. D.C. GENERATOR
115 V. D.C. LOAD
230 V. D.C. LOAD
115 V. D.C. GENERATOR
115 V. D.C. LOAD
115 V. D.C. LOAD
X
B.D.
G1
G2
PATH OF UNBALANCED NEUTRAL CURRENT IF SECONDARY NEUTRAL IS OPEN AT X. SECONDARY GROUND AT G1 APPLIES SECONDARY PHASE TO NEUTRAL VOLTAGE TO ENTIRE D.C. SYSTEM. BREAKDOWN OF TRANSFORMER INSULATION AT B.D. WITH GROUND ON PRIMARY AT G2 APPLIES PRIMARY VOLTAGE TO ENTIRE A.C. AND D.C. SYSTEMS.
Sketch submitted by A. R. Markland to show voltage rise

DISC GUIDING GOES MORE THAN HALF-WAY



The accurately machined guide ribs in the body are a positive center line for machining the shoulders against which seat rings are screwed into place. When renewing seat rings just screw them in—they're bound to fit perfectly—no scraping, lapping or machining necessary—then drop in the disc. That's how precision workmanship saves you time and money!

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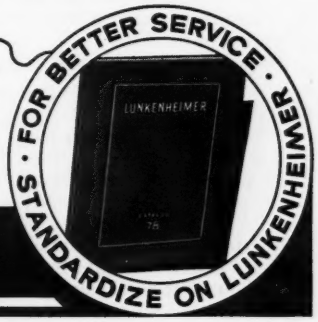

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Duplicate Third Prize Award

Gilbert J. Jantz
Milwaukee, Wis.

If the 110 v. d.c. loads are balanced there will not be any current flowing through the neutral or third wire, since these two loads will be connected in series across 220 v. and operate properly. However as these d.c. loads become unbalanced the difference of the d.c. load currents will flow through the

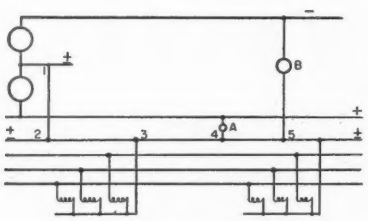


Diagram submitted by Gilbert J. Jantz

neutral wire to the generators and unbalancing the generator loads. The fact that two different types of current would flow over one ground wire has no special significance; therefore if all connections were good and uneven loads permitted on the d.c. generators, the system would work.

However since the neutral is grounded at each transformer bank, this proposed connection is prohibited by the National Electrical Code.

Ground Connection For Direct Current Systems, National Electrical Code. 1940, Section 2522.

"Direct-current systems which are to be grounded shall have the grounding connection made at one or more supply stations, but not at individual services nor elsewhere on the interior wiring."

Using a Ground Wire as a Current Carrying Conductor, National Electrical Code. 1940, Section 2521.

"The grounding of wiring systems, circuits, ... shall be so arranged that there will be no objectional passage of current over the grounding conductors. If an objectional flow of current occurs over a grounding conductor due to the use of multiple grounds, (1) one or more of such grounds shall be abandoned, or (2) their location shall be changed, or (3) the continuity of the conductor between the grounding connections shall be suitably interrupted."

In event of other opens occurring in the system the following might result.

1. In case of an open in the ground or neutral wire between connections 2 and 4, an unbalance in the d.c. loads would cause the difference in the load currents to return to the generators, via the transformer secondaries. Since this is direct current its passage through the transformer secondaries is inhibited only by the resistance of the secondaries and thus would, if of any appreciable value, burn out the transformer secondaries.

2. In case of an open connection between points 1 and 2, the d.c. loads are connected in series across the two generators also in series. A balanced load condition would result in no trouble, but any unbalancing of the d.c. loads would result in a change in resistance so that an increase current would flow through the load of lower resistance and possibly damage or burn it out.

3. An open circuit between connections 4 and 5 would result in all the load current of load B flowing through the transformer secondaries and cause over heating or burning out.

4. In event of an open between 1 and 2 the return path to the generator would be through the ground, causing electrolytic action to take place carrying metal from the a.c. ground to the ground at the d.c. generator.

General Comment

Among the other letters submitted, one deserving especial mention is that of James A. Caldwell of Rushville, Ind., because, as Mr. Caldwell explains, several years ago he chose a similar subject for a college thesis. "I am peculiarly interested in 'Our Hero's problem,'" he writes. "Several years ago I selected for my graduating thesis the following subject 'The Effect of Direct Current in the Grounded Conductor of a 3-phase 4-wire System.'

"It occurs to me that Our Hero's problem is quite similar to the assumed conditions for the experimental work on my thesis. At that time we attempted to simulate the conditions of a 3-phase 4-wire transmission line in parallel with a d.c. railway system.

"In the course of our experiments we took many oscillograms of the resultant of the alternating and direct current in the same conductor. I am enclosing a tracing of one of the most interesting. As I remember, this particular wave has a small second harmonic, a very unusual occurrence as currents produced by rotating equipment produces the odd rather than the even harmonics.

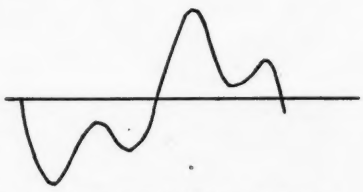
Now, getting back to Our Hero's problem, I am sure that he can use the same neutral for both circuits as far as his distribution is concerned, assuming that the two systems are in reasonable balance. There is one possible trouble he might encounter. If either the d.c. or the a.c. system is energized from the other system (motor-generator set or connector) it is possible that certain harmonics may develop to great enough magnitude to cause overheating of certain portions of the windings or set up a circulating current through the bearings and shaft of the machine.

"Should Our Hero, however, wish to abide by the National Electrical Code I am afraid he would be unable to use the common neutral.

Kenneth M. Stott of the Hercules Powder Co. also pointed to the potential hazard inherent in the hook-up. "Our Hero," he says, "proves that he has a tendency towards genius when his endorsement of superior intellect makes him hesitate to employ an arrangement of doubtful feasibility. . . . He might 'get away' with the hook-up for an indefinite period, yet there would always exist a potential hazard. As soon as the d.c. neutral is connected to the a.c. neutral, the neutral of the d.c. and, hence, the d.c. system is raised to an a.c. potential relative to the a.c. service lines. Also, should one of the a.c. power lines become grounded, then there exists an a.c. potential between ground and the d.c. system. Finally, a grounding of an a.c. line could exist and then a breakdown to ground develop in the d.c. circuits and this would allow alternating current to flow through the d.c. system, and if conditions were correct this might result in a high potential of the neutral relative to ground."

He Says It Can't Be Done

Among the few who stated definitely that Our Hero's scheme would not work was Harold Hansen of Canton, N. C. From the standpoint from which he analyzed the problem he was correct in his opinion, but he assumed that the 3 wire d.c. system was supplied by a 3 wire generator. Quoting from his letter, he states, "The proposal to use the a.c. circuit neutral to convey the direct current will not work as there is still no path for the direct current to flow back to the coils in the direct current generator. An understanding of the design of d.c. generators that deliver current at two different voltages is necessary to realize the impossibility of the proposed connection."

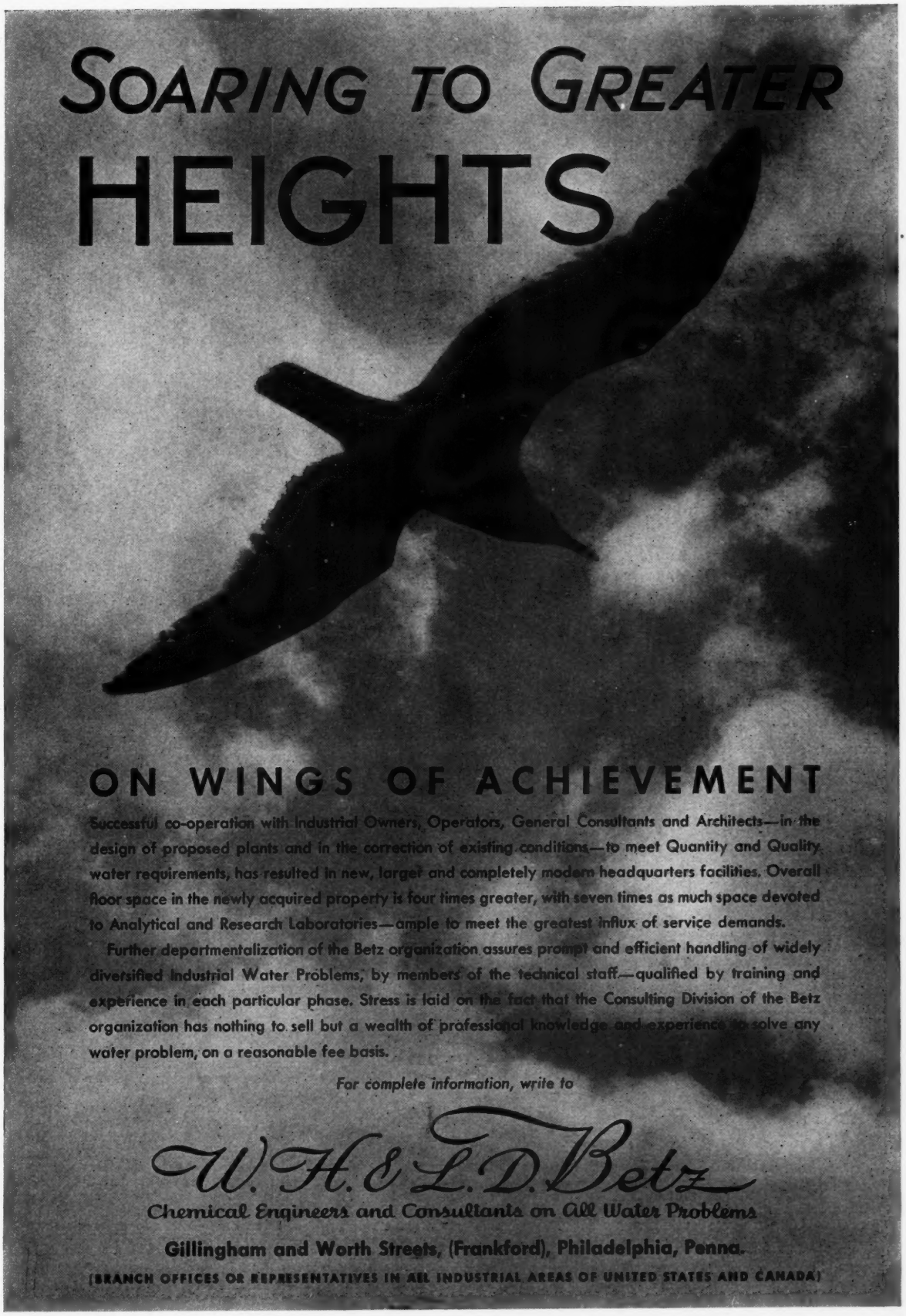


Oscillograph trace showing resultant of a.c. and d.c. currents

Following this, Mr. Hansen presents a sketch (not shown here because of lack of space) to show why this is so.

This assumption of the use of a 3 wire generator is not justified, however, because in the original sketch in the May issue two 2 wire generators were shown supplying the 3 wire d.c. system.

Everything considered, Our Hero's plan is feasible and if the two systems are kept in reasonable state of balance he should encounter little difficulty. There are some hazards to watch out for and furthermore if he wants to comply with the Underwriters' rules, he had better study the National Electrical Code rather carefully.



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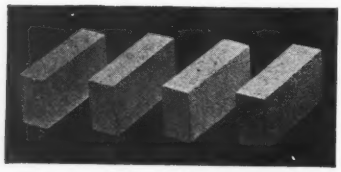
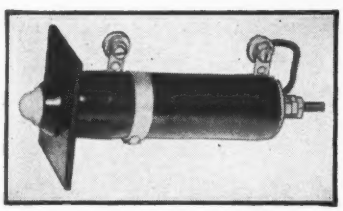


four temperature limits: JM-16, for exposed service to 1600 deg. F. and for back-up service to 2000 deg. F.; and JM-20, JM-23, and JM-26 for exposed or back-up temperatures to 2000, 2300 and 2600 deg. F., respectively.

The new insulating fire brick are produced from a plastic refractory clay and an organic filler which, upon being burnt out during the manufacturing process, gives a uniform, controlled pore structure to each of the various types, and imparts the characteristics of light weight, strength, and high insulating value.

Handy Compact Indicating Lamps

AN IMPROVED line of indicating lamps for visual or pilot light indication on switchboards, switchgear, panels and controls has been developed by Allis-Chalmers Mfg. Co., Milwaukee, Wis. These rugged lamps are compact, simple in construction, and require very little panel space for mounting.

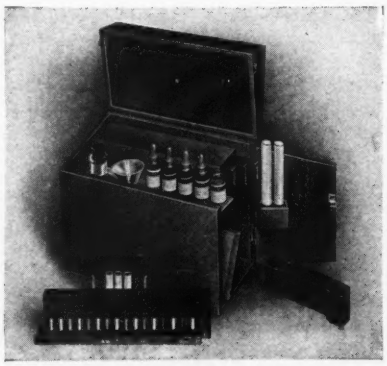


An outstanding feature is the use of special material in the color cap which allows less lamp voltage with equal brilliance and corresponding longer lamp life consuming only approximately 4 w. The color caps are threaded and easily removed and replaced from the front of the board.

The receptacle is made of insulating material and mounts from the front of the panel through a ¾ in. hole. The resistor slips over the receptacle, taking very little space and allowing a stronger resistor construction. Strong, resilient, metal contact clips firmly hold the lamp bulb in position. The assembly mounts on any thickness of panel up to 2 in., without panel counterboring. Binding screws provide easy means for making connections. The lamp slips into the receptacle from the front after the color cap is unscrewed. The lamp bulb may be removed or replaced without the use of tongs, wrenches, pullers or other tools.

Phosphate and pH Comparators

NEW OUTFITS for determining pH and phosphates in boiler water to control corrosion and scale formation have been announced by W. A. Taylor & Co., Baltimore, Md. Two phosphate sets are available, the High Phosphate Comparator (5-100 p.p.m.) and the Low Phosphate Comparator (0-25 p.p.m.).

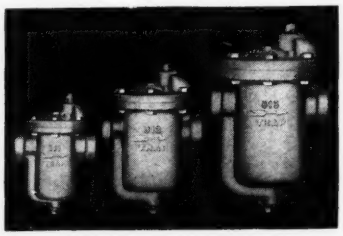


The Boiler Water Comparator consists of either a high or low phosphate comparator and 3 pH color standard slides, cresol red (pH 7.2-8.8), phthalein red, (pH 8.6-10.2) and acyl red (pH 10.0-11.6), pH indicator solutions and reagents and equipment for the phosphate determination. All this equipment is contained in a portable wooden case 12 in. long, 6 in. wide and 9⅜ in. high.

The method used in the phosphate determination avoids interfering reactions with constituents other than phosphates. 10,000 p.p.m. of silica as SiO_2, 100 p.p.m. of ferrous or ferric iron, or 1000 p.p.m. of sulfites cause no error. Reagents are extremely stable as they give accurate results after storage for over 5 yr. All color standards carry an unlimited guarantee against fading.

Side Inlet Steam Traps

THREE additions to its standard line of side inlet steam traps have been announced by Armstrong Machine Works, Three Rivers, Mich., designated as 811 for 800-1000 lb. per hour; 812, 1600-2000 lb.; and 813, 3000-4400 lb. All feature the previous basic body design for side



inlet traps, in which trap cap carries complete mechanism, removable without disturbing pipe connections; trap body permanently in the line; horizontal, straight-through pipe connections, where practical.

Traps are for operation on pressures up to 250 lb. gage, with inverted bucket operating mechanism, and available with blast type thermic air vent buckets and internal type check valves as optional extra equipment.

Metal-Clad Switchgear for Oil Refineries

METAL-CLAD switchgear specially designed for locations where the gear may be subject to corrosive and hazardous atmospheres has been recently announced by the General Electric Co. This vertical-lift-type switchgear is available in ratings up to and including 15,000 v. with breaker ratings as high as 500,000 kv-a. to control incoming lines, feeders, and motors. The equipment is for either indoor or outdoor installations.

Its removable front and rear panels are fitted against a neoprene-covered felt gasket retained in a protecting channel. Construction of the complete housing is as an individual unit, facilitating addition of circuit units. The secondary control devices are mounted within each enclosure in a separate explosion-proof box.

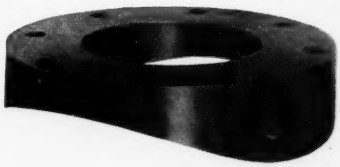
The oil circuit breaker in the equipment can be raised or lowered to the connected or disconnected position without opening the front door. A window in the door allows the operator to determine visually the position of the circuit breaker. An interlocking arrangement prevents lowering or raising a closed circuit breaker. External surfaces of the equipment have a special corrosion-resistant finish and the inner surface of the roof and side sheets are lined with pulverized cork to prevent troublesome condensation.

LENAPE A POLICY FOR *ACTION*

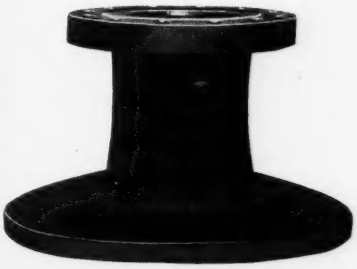
Seamless Heavy Wall Welding Neck

"Type R" Manhole Neck

LENAPE'S contribution to the defense program is increased production to insure continuous, prompt flow of standard basic accessories for pressure vessels in marine, power, chemical and refinery applications—for which semi-processed and raw materials can be adequately stocked. This page presents the most active types which we offer for normal shipment.



Welding Type Studding Outlet



Straight High Type Nozzle

Seamless Manhole Neck

Elliptical Manhole Saddle and Fittings

RED MAN PRODUCTS

LENAPE HYDRAULIC PRESSING & FORGING CO.

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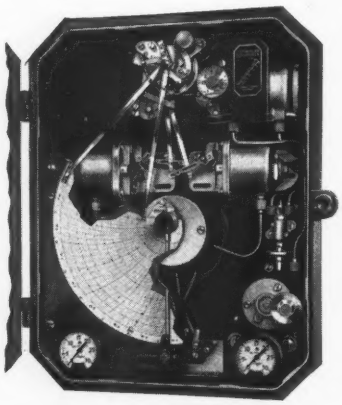
VINSON SUPPLY CO. Tulsa, Oklahoma	**JOHN B. ASTELL & CO., INC.** New York, N.Y.	**HOWARD SUPPLY CO.** Los Angeles, Cal.	**ROBERT F. LANIER & CO.** Houston, Texas	**HERBERT P. SMITH CO.** Pittsburgh, Penna.

Ratio Controller

For Applications where a temperature, pressure, rate of flow or liquid level must be controlled in a desired ratio or differential to another related variable, a highly adaptable, easily convertible instrument is now offered by the Taylor Instrument Cos., Rochester, N. Y.



With the new direct-setting Taylor Ratio Controller the ratio is changed by a simple screwdriver adjustment directly on a calibrated dial throughout the range of 0:1 to 3:1, direct or inverse. With this new instrument it is unnecessary to disturb the processing or remove the chart plate while making ratio adjustments.

The controller has two measuring systems, one the adjusting system which indicates or records only, and the other, the controlling system which may either indicate or record. The adjusting system resets the control point of the controlling system through a linkage arrangement according to a predetermined ratio. The action of the controlling system is the same as the 120R Series Fulscopes and may be used as a single duty bi-recording controller when the ratio setting is zero. Both indicating and recording models of the Ratio Controller are available.

New Tire Prevents Sparks

Industrial tires made with a special rubber compound with a million times the electrical conductivity of tires made of ordinary rubber, have been developed by The B. F. Goodrich Co., Akron, Ohio, for use in manufacturing plants where static electricity constitutes a fire and explosion hazard. Function of the new tires, available in a complete range of sizes for pressed-on and vulcon types, is to prevent the accumulation of static electricity large enough to produce a spark when the vehicle comes in contact with any other object.

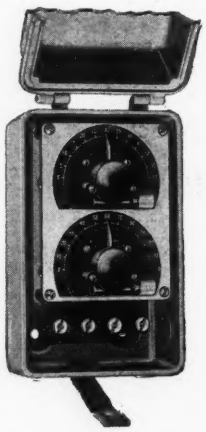
The company's tests showed that where industrial trucks or tractors operate on floors of cement, brick, stone or metal, the new tires continually dissipate the static electricity, keeping the vehicle and the floor at the same electrical potential. The new product, called Conductor Industrial Tires, is expected to be of special value to plants engaged in the manufacture of armament, gun-powder or other inflammable or explosive materials or products. They are an outgrowth of research which literally "changed the leopard's spots" by altering rubber from an unusual insulating material into a conductor of electricity.

One of the first applications of the special compound was for tail wheel tires for aircraft to bleed off static electricity, built up during the airplane's flight, upon contact of the wheels with the ground.

Double Reset Timer

An Automatic double reset timer has been recently designed by the R.W. Cramer Co., Inc., Centerbrook, Conn., for rapidly repeating time cycle. Consisting of two Cramer Reset Timer mechanisms mounted upon a control panel and controlling common electrical circuits with micrometer adjustments and band-spread time scales to fascilitate accurate settings. Either conduit or BX type wiring may be used and the housing may be locked as protection against alteration of critical timing of industrial processes.

To furnish a 10 sec. impulse every 90 sec. for signalling or heating control purposes, a 120 and a 15 sec. timer are combined, one timer being set to close the control circuit in 90 sec., the other member set for 10 sec. The switching arrangement of the entire instrument can be used as a single-pole, double-throw switch.

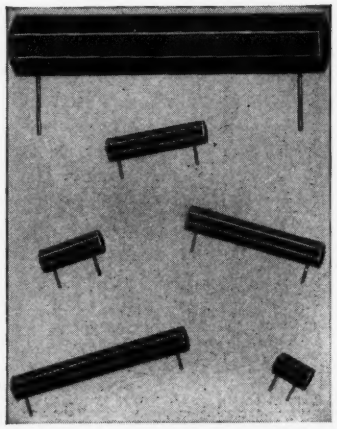


In operation, the first timer closes the control circuit at the end of 90 sec.; the second timer then operates simultaneously with the delivery of the desired impulse for a period of 10 sec. Meanwhile, the first timer has reset and is again put into operation at the end of the 10 sec. interval when the second timer opens the control circuit and cuts off the impulse. Operation is thus continuous and according to the sequence determined by the settings of the timers until the external control switch is opened.

Timers are furnished for 110 or 220 v. and 50 or 60 cycle operation, time ranges available for each of the individual timers being 15, 30, 60 and 120 seconds, maximum, at present. Current carrying capacity of the switches is 10 amp. at 110 v. 60 cycles.

Temperature Resistors

A new line of negative temperature coefficient resistors, has been recently announced by the Keystone Carbon Co., St. Marys, Pa. The new resistor material is a hard, black, non-metallic substance, the chief characteristic of which is a decrease in electrical resistance with an increase in temperature. This property makes the material useful where it is desired to reduce or eliminate initial cur-

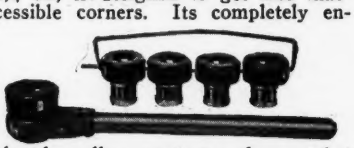


rent surges, to secure a time delay or gradual building-up of the current through a piece of equipment, to provide temperature compensation in apparatus or equipment which exhibit rising resistance with increase in temperature, and for other applications where a negative temperature coefficient is required.

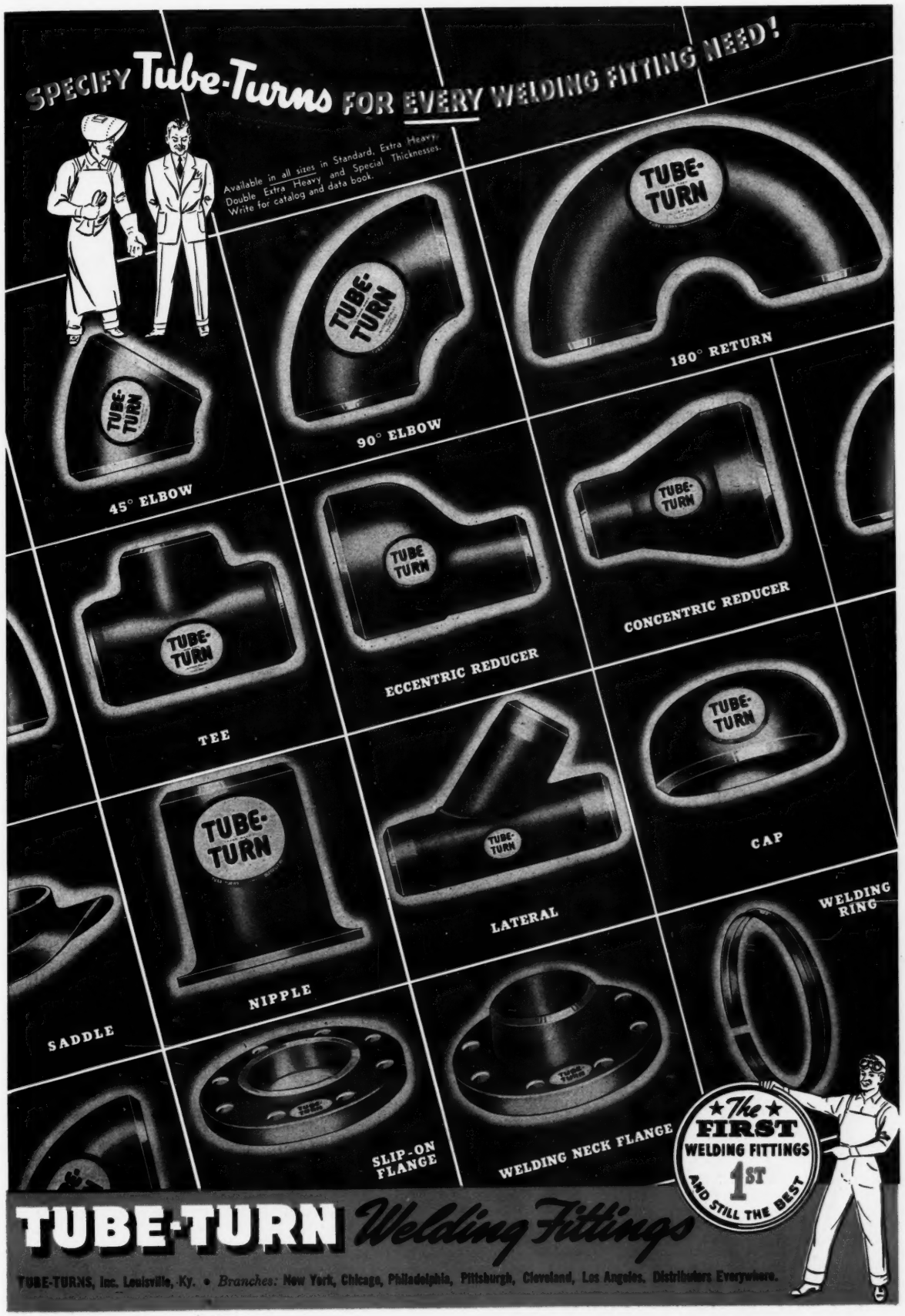
The temperature of a resistor made of this material can be changed either externally by a change in ambient temperature, or internally by heat developed by passage of current through the resistor, or by a combination of both. Change of resistance with temperature change occurs in the region of ordinary temperatures; namely, 0—150 deg. C. Resistors can be produced in a wide range of resistance values, which remain stable for a long period of time provided they are not excessively overloaded. The new resistors are mechanically strong and can be supplied in a wide variety of sizes and shapes. Connections are "moulded-in" to provide secure and permanent electrical contact.

Diestocks with Segmental Dies

Two Diestocks with segmental dies have been recently announced by Armstrong Mfg. Co., Bridgeport, Conn. The new Armstrong-Bridgeport Drophead Ratchet Diestock, made in two sizes and covering a range of ⅛ to 1¼ in., is designed to get into inaccessible corners. Its completely en-



closed collar protects the ratchet mechanism from dirt and chips. The diehead may be changed rapidly, and the threading direction is reversible at the touch of a thumb. Dieheads are securely held in place during threading operation.


SPECIFY Tube-Turns FOR EVERY WELDING FITTING NEED!
Available in all sizes in Standard, Extra Heavy, Double Extra Heavy and Special Thicknesses. Write for catalog and data book.
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The FIRST WELDING FITTINGS 1ST AND STILL THE BEST
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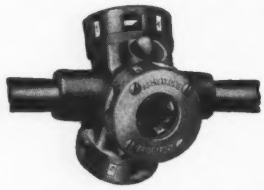
TUBE-TURNS, Inc. Louisville, Ky. • Branches: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Los Angeles. Distributors Everywhere.

Each of Armstrong-Bridgeport's new 3-way Diestocks really serves as three stocks in one handy tool. It is supplied for ⅜ to ¾ in. and ½ to 1 in. pipe, or with special dies for brass pipe or conduit.

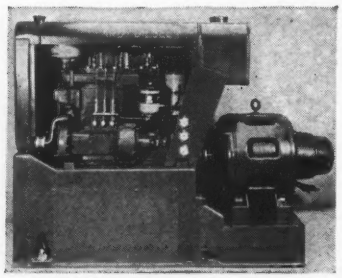
Greatly increased efficiency and convenience are features of the 3-way Diestock. Die changing on the job is eliminated because the most frequently used sizes are always in the stock, ready for use. This means that



on many jobs the 3-way is the only diestock that need be carried. Many convenient combinations are possible with this new tool. For example, because several jobs can be done with the one diestock, the user can insert any three sets of segmental dies at once—three dies for three sizes of pipe, or a die for conduit, copper or brass can be combined with two others for several purposes.

Diesel Engine Package

For continuous duty in factory and other stationary applications at loads of 25 hp. at 1200 r.p.m. or intermittent loads of 30 hp., R. H. Sheppard Co., Hanover, Pa., has developed an entirely self-contained Diesel engine which can be placed on a factory floor and put into service without any extra equipment. The unit has three cylinders, 4 in. bore, 5 in. stroke, gear driven camshaft, flyball governor with adjustable speed regulation, lubrication effected by forced feed gear type pump, cooling accomplished by circulating water under the thermostat control through radiator by means of a belt driven centrifugal pump.



Part of the standard equipment is a clutch and power take-off which makes its application to any driven equipment a simple matter since the engine is mounted on a box-shape base in which is placed the starting battery. With the fuel tank at one end of the unit and the radiator at the other, the unit is extremely compact as to space requirements.

Among the features of design contributing to high fuel economy of the unit is the pre-combustion chamber into which the fuel is injected on its way to the cylinder. This chamber is spherical in shape, the lower two-thirds being formed of heat resisting steel and the upper third formed in the cylinder head, with three passages of different diameters and divergent angles connecting the chamber to the cylinder. By this means turbulence is secured and the flame does not impinge directly on either the side of the piston or the cylinder walls. The piston crown is cooled from the underside by an oil spray directly beneath the point of impingement.

Fuel injection is by means of a variable stroke type pump that effectively prevents dribble. The governor is mounted directly on the end of the fuel pump camshaft and the single governor spring is external in relation to the governor and although it is enclosed by a case, is readily accessible by removing only two screws.

Sheppard packaged Diesel power unit with all accessories weighs approximately 1900 lb., the engine alone weighing 1200 lb.

High-Speed Slotting Tools

An Assortment of ten high-speed steel slotting tools has been recently announced by Experimental Tool & Die Co., Detroit, Mich. These are accessories to the Universal Slotmaster—a slotting head that can be used on all milling machines, providing double duty facilities. The Slotmaster can be used as a

vertical or horizontal slotter and shaper for cutting key-ways, templates, splines, internal gears, and for slotting out precision blanking dies and molds, or wherever sharp corners and special shapes are machined.

It is operated over the milling machine table and requires but little time to change over from one head to the other and back again.

Non-Staining Packing

Recently released by Greene, Tweed & Co., New York, N. Y., a non-staining packing known as Klero is now available for apparatus handling liquids that must be kept unstained or uncontaminated. This packing is snow white, with odorless, tasteless, edible and chemically-resistant lubricant. Being made of asbestos yarn, it is suitable for high temperatures, and its braid-over-braid construction prevents accumulation of solid materials in the packing. Its use is specially in food and drug industries, paper and pulp mills, ceramic plants, textile plants, and chemical process work.

Split Journal Bearings

A New and improved line of solid and split journal bearings, is announced by The Jeffrey Mfg. Co., Columbus, Ohio. Of accurate dimensions with modern rounded lines and smooth gun metal finish, these precision-made bearings have machined bases and faced ends. Height to center line of shaft

is rigidly maintained. The babbitted bores are broached to smooth hard surface and require no "wearing in".

Both styles are tapped for grease cups or pressure fittings. An ample storage groove in the top provides proper distribution of lubricant. In addition, the split bearing has feeder grooves on each side. Individual containers are furnished for easy handling and protection in shipping.

Industrial Multi-Breaker

Square D Co., Detroit, Mich., announced recently a new Industrial Multi-breaker for use on 230 v. a.c. systems, in 2 and 3-pole forms, in capacities from 15 to 100 amp. With dust-resisting enclosure, quick make and break mechanism and white target signal which appears whenever the breaker trips. Front operation of the breaker unit permits close ganging of units with provision for padlocking in either "on" or "off" positions. Overload on any pole will cause all poles to trip, thus eliminating possibility of single phasing of polyphase circuits. A thermal element affords time lag on momentary overloads while a magnetic trip feature causes instantaneous tripping on heavy short circuits.

Multi-Purpose Tool Accessory

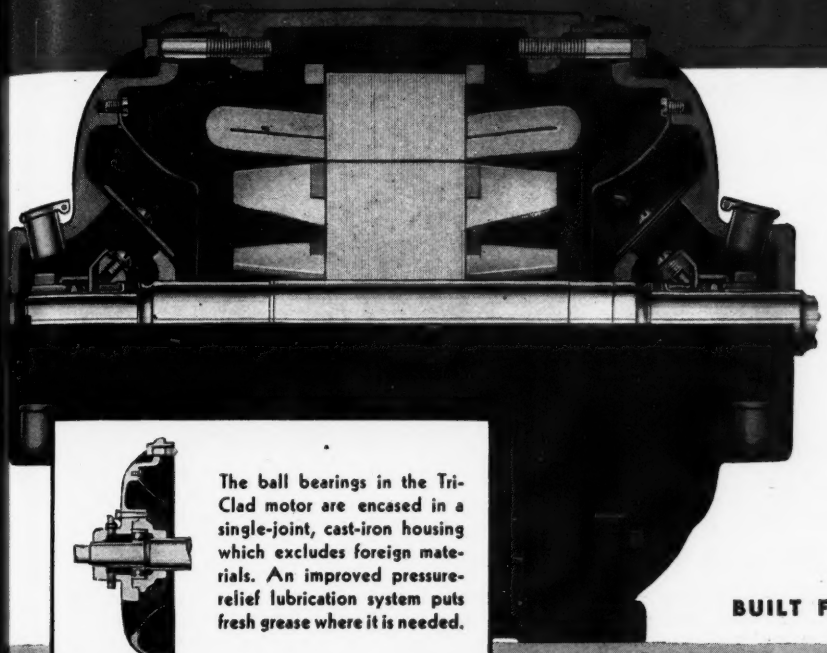
A Stand into which the Senior Model Multi-purpose Tool may be clamped has been recently announced by H & H Research Co., Detroit, Mich.

An ingenious accessory which greatly

broadens the use of this tool with reciprocating action, clamped into position in the stand, it provides a unique filing machine for most types of work. It may be used generally in cases where the work is lighter than the tool by bringing the work to the tool, instead of taking the tool to the work, thus eliminating the necessity of clamping each piece into stationary position on burring and filing operations.

We Cut Your MAINTENANCE WORRIES

WHEN WE CUT THE ENDS OFF THE BEARINGS!



The ball bearings in the Tri-Clad motor are encased in a single-joint, cast-iron housing which excludes foreign materials. An improved pressure-relief lubrication system puts fresh grease where it is needed.

In the Tri-Clad motor, G.E. uses a SHORTER sleeve bearing for LONGER life

This *shortened* sleeve bearing has higher load-carrying capacity and longer life. Positive lubrication is assured by its corrosion-resisting oil ring and improved spiral grooving—the bearing runs full of oil regardless of the direction from which the load is imposed.

1 to 20 hp now available.

BUILT FOR PROTECTION FIRST . . . . TO LAST!

TRI CLAD

REG. U.S. PAT. OFF.

INDUCTION MOTORS

GIVE EXTRA PROTECTION 3 WAYS

Extra Protection

AGAINST

PHYSICAL DAMAGE

The strong, one-piece, cast-iron frame and end shields, with upper portion completely enclosed, protect vital motor parts from external blows, flying chips, settling dust, and dripping liquids.

Extra Protection

AGAINST

ELECTRICAL BREAKDOWN

Stator windings of Formex wire resist moisture, oil, and "heat shock." A tough, synthetic resin bonds the coils, and a coat of Glyptal No. 1201 Red on the end windings completes the insulation.

Extra Protection

AGAINST

OPERATING WEAR AND TEAR

For years, G-E motor designers have been experimenting with sleeve bearings of all kinds. They have found that a shorter sleeve bearing—one with new diameter-to-length proportions and a more effective spiral grooving—is a fundamentally better bearing; that such a bearing could successfully withstand the stress imposed by short-center, hinged-base drives and similar applications.

In addition, the new sleeve-bearing housing on Tri-Clad motors is dust- and oil-tight. These and many other features are your assurance of a dependable, free-running motor.

You'll find that Tri-Clad motors are unusually quiet and smooth running. They'll give your production *extra protection* during *extra* years of service. General Electric Co., Schenectady, N. Y.

Write for Bulletin GEA-3580 and specify Tri-Clad on your next motor order.

GENERAL ELECTRIC

Butt-Welding Elbows

RECENTLY developed is the Reducing Butt-Welding Elbow by the Midwest Piping and Supply Co., Inc., St. Louis, Mo. In a pipe line where it is necessary to change both direction and pipe size, this reducing elbow will take the place of two welding fittings.

After forming, welding and compression-sizing operations these are stress relieved. Features include machine faced and beveled ends, wrought steel construction and are made in standard and extra heavy weight.

Combination Starters

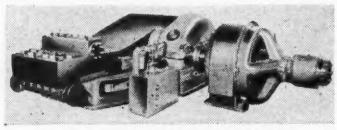
A UNIQUE handle-locking arrangement and a compact, high-capacity disconnect switch are among several new features of a new line of Bulletin 712 combination starters recently developed by Allen-Bradley Co., Milwaukee, Wis. By combining a magnetic switch with a hand disconnect switch in the same enclosure, these starters save wiring, insure greater safety to the operator, and result in compact installation of improved appearance.

The combination starters are available in four sizes in a variety of enclosures, with or without fuse clips. Ratings range from 2 hp., 220-440-550 v. for the Size 0 starters, to 30 hp., 220 v., and 50 hp., 440-550 v. for the Size 3 starters. All sizes have an interrupting capacity of at least ten times the maximum horsepower rating. Locked rotor currents are disrupted by either the solenoid switch or the disconnect switch.

Both disconnect switch and solenoid switch have silver alloy contacts which do not form insulating oxides. Therefore, filing and dressing of contacts are eliminated, resulting in longer contact life. All contacts and wiring are in front for easy installation. White-enameled interiors make terminals and other details stand out in dark locations.

High Pressure Pumps

A NEW LINE of high pressure pumps has recently been announced by Baldwin Southwark Division of The Baldwin Locomotive Works, designed to handle comparatively large volumes of water in conjunction with hydraulic press installations. This Horizontal Triplex Pump employs three pistons, which provide a 60 deg. overlap in discharge impulses. The 12 in. stroke pump discharge ranges from 23 g.p.m. at 7500 p.s.i. to 160 g.p.m. at 1000 p.s.i.; and the 18 in. stroke unit from 88 g.p.m. at 7500 p.s.i. to 685 g.p.m. at 1000 p.s.i.



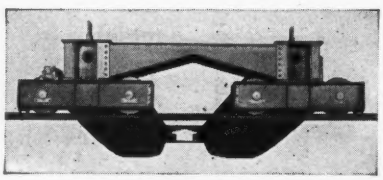
Pump frame is a one piece semi-steel casting carrying bearings for the rotating parts, also the gear case, containing double helical single-reduction gears.

Rotating elements are on roller bearings, except the crank ends of the connecting rods which use steel-backed, babbitt-lined bearings. Valves are of Cramp Super-strength bronze, seats of stainless steel. Cylinder block is a large one-piece steel forging, ground and polished plungers being held in their crossheads to permit self-alinement with respect to the bronze bushings in the cylinder block. Packing space and plunger glands are separated from the crankcase to seal the latter and prevent water mixing with the crankcase lubricating oil.

Designed primarily for pressures in excess of 1000 p.s.i., Southwark Horizontal Triplex Pumps are built in 12, 15 and 18 in. stroke, for direct coupling to 125, 250 and 500 hp. motors respectively.

Power House Cranes

FOR LARGE heavy-capacity cranes of the type used for power houses and other moderate services, requiring eight bridge track wheels, The Cleveland Crane and Engineering Co., Wickliffe, Ohio, has developed a novel crane end tie which is extremely simple in design. The tie is



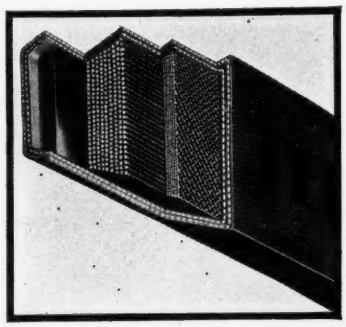
made of one heavy rolled steel plate that is first cut to shape and then bent to form a box section. Bending is done "cold" on a Steelweld Bending Press, which is another of Cleveland Crane's products. Into the box section are welded reinforcing diaphragms to effect the rigidity required. This end tie construction is known as a "spring type," since it has sufficient give or spring to allow all wheels to bear properly on the track at all times, despite runway irregularities.

Roll Crusher Adjustment

RECENTLY announced by McNally Pittsburg Mfg. Co., Chicago, Ill., is a new and simple ratchet adjustment, applied on both sides of double roll crushers which provides an even plane of production at all times. Double roll crushers are usually manufactured with separate adjustment screws on each side of the machine frame for the adjstment of the crushing rolls, which makes roll adjustment more or less time-consuming and, through hasty adjustment, may bring the rolls closer at one end than the other, causing worn bearings and production of an even size range in material crushed. An indicator gives the operator direct and simple means of tabulating results on material crushed at different roll settings.

Super 7 V-Belt

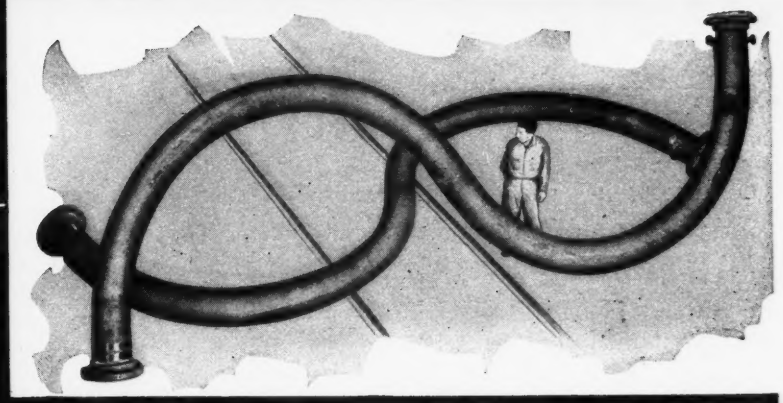
ALLIS-CHALMERS Mfg. Co., Milwaukee, Wis., has made fundamental improvements in V-belt structure and announces that all Texrope V-belts are now of the new Super 7 laminated design. Cords in the new Super 7 are smaller, permitting the use of more cords per belt with a resulting greater strength and less stretch. Each cord is individually imbedded in heat dissipating rubber to reduce internal belt



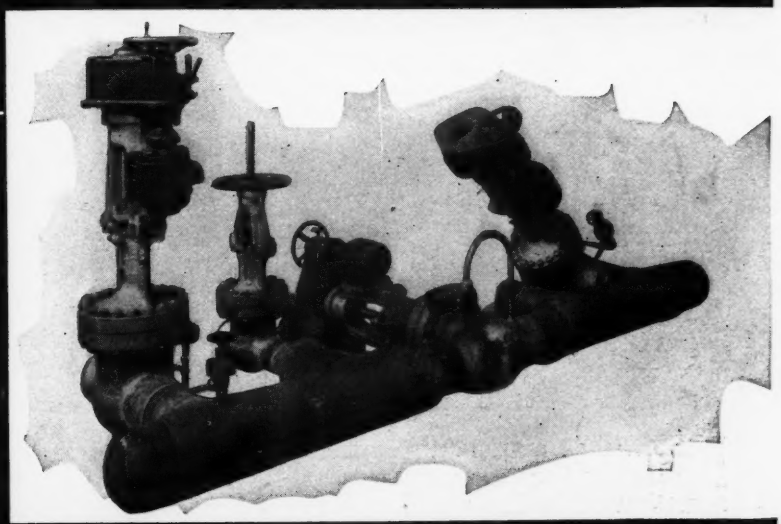
degeneration. These belts are made in matched sets to assure uniform, smooth running, highly efficient drives. Each element of the belt is designed to fulfill an individual function. The live rubber bottom cushion absorbs the ceaseless impacts of operation. The central cord portion transmits power at the effective pitch diameter. The bias cut fabric prevents "dishing" and assures transverse stability. The 2-ply rubber-impregnated fabric cover prevents destructive agents from reaching the vital belt elements, resulting in a high grip co-efficient between belt and sheave walls.

For control of lighting of indoor and outdoor lights according to lighting level needed, United Cinephone Corp., Torrington, Conn., is offering its Sun-Switch with photoelectric tubes controlling relay for 110-v., 50 or 60 cycle circuits so that light will be automatically turned on when needed. Setting is made for on and off level, action then being automatic. Installation is in a weatherproof aluminum box with cork gaskets.

MIDWEST *Alloy* PIPING



14" O.D. Chromium-Molybdenum pipe bends with Van Stone laps. Entire bends annealed after fabrication.



Carbon-Molybdenum header stress relieved in furnace before welding on valves which were welded by preheating and stress relieving with induction method.

PRESSURE piping users have found that alloy tubing presents many problems and difficulties not encountered when low carbon steel materials are used. Some have learned by bitter experience that the utmost care must be exercised in selecting a fabricator . . . one who has wide experience in the special manufacturing procedures required by the various alloys. It is also essential that the fabricator's welders be skilled on welding alloy tubing . . . and that he have the heat treating furnaces and other special equipment needed.

Each of the three Midwest plants is thoroughly familiar with all the "do's" and "don'ts" peculiar to the fabrication of alloy tubing. Midwest has welders qualified on the alloys . . . and Midwest has the special equipment so essential to the successful fabrication of alloy tubing.

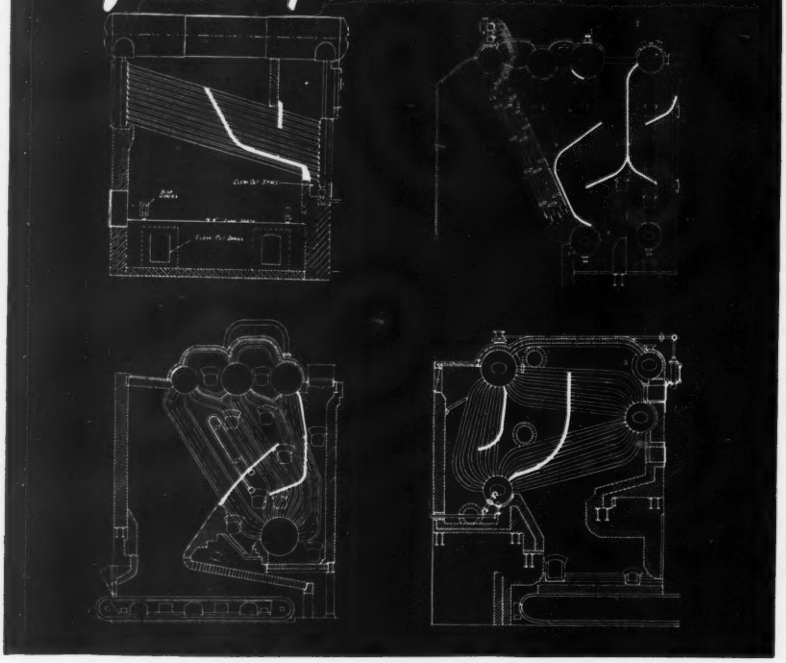
Whenever you need alloy piping, you will find it definitely advantageous to get in touch with the nearest Midwest office.

MIDWEST PIPING & SUPPLY COMPANY, INC.

Main Office: 1450 S. Second Street, St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • *Sales Offices:* Chicago—946 Marquette Building • Houston—1716 Second National Bank Building • Los Angeles—520 Anderson Street • New York—(Eastern Division) 30 Church Street • Tulsa—533 Maya Building.

Get that EXTRA POWER from your BOILERS



PRESENT demands on steam generating plants are so heavy that the proper type, location and construction of baffle walls are of the utmost importance. Enco Streamlined Baffles lower operating and maintenance costs—**but most important** they will increase the output of your boilers.

We would like to tell you more about Enco Streamlined Baffles—why their installation will result in increased capacity and all-around operating efficiency.

Write for Bulletin BW 40 or, for quick action, send blue prints and operating data. There is no obligation.

THE ENGINEER COMPANY
75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles
PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

Bronze on Steel Bearing

IN ANSWER to industry's demand for increased speeds and bearing loads, longer life and smoother operation, Johnson Bronze Co., New Castle, Pa., has developed a pre-cast bearing bronze on steel. This is essentially a thin wall, laminated type bearing that combines the bearing qualities of a high grade bronze alloy with the strength of steel. The bearing surface metal is S.A.E. 64—80 per cent copper, 10 per cent tin and 10 per cent lead. This alloy is first cast into solid bronze bars, thus uniting the metals chemically and forming a definite copper-tin eutectic, with the lead trapped in the interstices. This process definitely establishes the grain structure of the alloy and the resulting bearings.

The center of the casting is then removed by drilling and the borings thus obtained are reduced to a powder, treated in a hydrogen furnace to remove all oxides and then firmly bonded to strip steel. Bearings made from bronze on steel in strip form are manufactured by a stamping and forming process. These bearings are high in Brinell hardness, offer great resistance to pounding and shock, and have a low coefficient of friction. Pre-cast bearing bronze on steel is available, either plain or graphited, as finished bearings, washers, strips or in rolls up to 400 ft. in length.

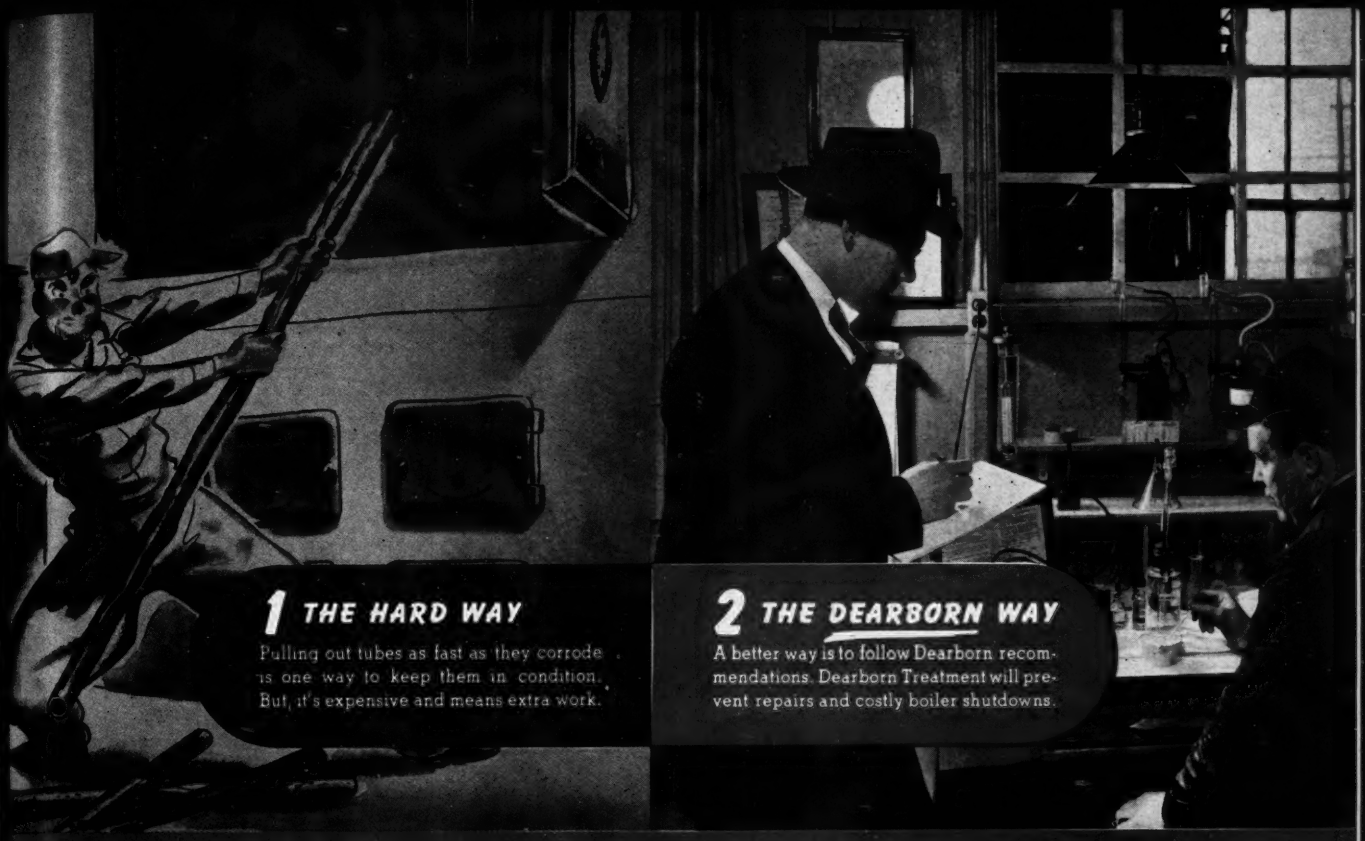
Ameripol Gaskets

AMERIPOL, a new synthetic rubber, is now being used for various forms of gaskets and rings assembled with machines to keep oil or grease confined in bearings, according to an announcement by The B. F. Goodrich Co., Akron, Ohio. These products are made by either the molded or lathe cut methods. This material does not swell at all in gasoline at room temperatures, and after immersion in oil for long periods it does not swell materially, and retains a high degree of flexibility and abrasion resistance.

Among other recent uses for Ameripol are lathe cut oil sealing gaskets for automobile steering columns, lathe cut gaskets for air lines handling oil laden air, lathe cut rings used as a sealing part on a dry dust collector, and other molded seals for automobiles, washing machines and other equipment.

With increase of coal storage piles, due to defense program needs, use of Hot Spot Indicators offered by Coal Specialties Co., New York, N. Y., to signal spontaneous overheating is increasing. The indicator is inserted at critical points in the storage pile to show abnormal rise in temperature. Each indicator, when in place, is said to have sensitive range to guard approximately 100 to 300 tons of coal piled 15 to 30 ft. high.

For finishing or refinishing exterior walls of wood, concrete, brick, tile or metal, a new builders' plastic, called Wet-X-Hole has been recently announced by Rogear Co., New York, N. Y. It is applicable in thickness of $\frac{1}{16}$ in. or less by brush, trowel or spray gun in fine, smooth or coarse stipple, with no preparation for wire mesh or wooden structures. Plasticity avoids peeling or cracking when applied direct to metal surfaces.



1 THE HARD WAY

Pulling out tubes as fast as they corrode is one way to keep them in condition. But, it's expensive and means extra work.

2 THE DEARBORN WAY

A better way is to follow Dearborn recommendations. Dearborn Treatment will prevent repairs and costly boiler shutdowns.

TWO WAYS to keep your Boiler Tubes and Sheets free from CORROSION

All boiler waters contain dissolved oxygen and other corrosion accelerators which weaken tubes, sheets, drums, and feed lines to the point where costly repairs are necessary.

You can prevent corrosion in your boilers with Dearborn Water Treatment and Engineering Service. Dearborn engineers first make a thorough study of water and plant operating conditions. Then, trained technicians in modern Dearborn laboratories make a complete chemical analysis of the feed-water. Next, the proper treatment and control methods are recommended. Feeding equipment is then installed and instructions given in water testing and treatment control. Finally, frequent checkups insure satisfactory results.

Dearborn Treatment is balanced to provide full protection against scale as well as against corrosion, and to reduce the possibility of steam contamination. Treatment can be controlled to disintegrate scale which may already be present, without boiler shutdowns. See your Dearborn representative.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Avenue, Chicago, Ill.

Prevent Water Troubles THE DEARBORN WAY

Dearborn
TRADE MARK REGISTERED

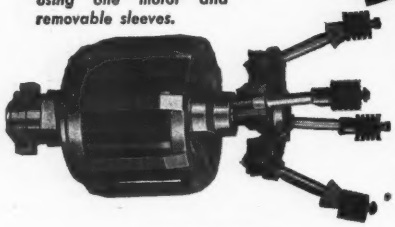
WATER TREATMENT and Engineering Service

NEW YORK · LOS ANGELES · TORONTO and PRINCIPAL CITIES

BIG TUBES LITTLE TUBES
CURVED TUBES BENT TUBES
ALL TUBES

Clean them WITH .. LAGONDA-LIBERTY TUBE CLEANERS

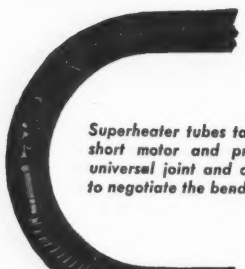
Cleaning of several sizes of large tubes or pipes can be accomplished by using one motor and removable sleeves.



If a tube can be cleaned mechanically, Elliott has the cleaner to do it! This means a lot of tube cleaners. It also means a lot of experience. Both of these factors are essential to the correct cleaner selection for *your* particular tube cleaning job.

The cleaners pictured at the left are *extreme cases,* which will give some idea of the many sizes and types that are ready to do a speedy, time-saving job for you. Elliott engineers, at Tube Cleaning Headquarters, are eager to help you in your selection of the right cleaners for your particular work.

Superheater tubes take a short motor and proper universal joint and cutter to negotiate the bends.



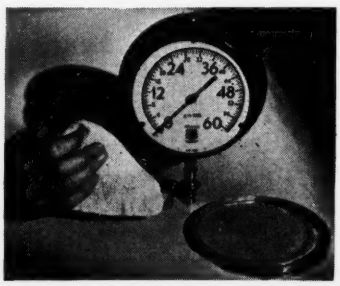
For extremely short radius bends a compact cleaner with hinge coupling and telescoping cutter is available.

You'll want the "inside story" on tube cleaning. It's all in the Lagonda-Liberty Bulletin. Write for your copy today.

ELLIOTT COMPANY
LAGONDA-LIBERTY
Tube Cleaner Dept., SPRINGFIELD, OHIO
District Offices in Principal Cities Y-162

Plastic Gage Dial

A NEW plastic gage dial has been recently developed by the Ashcroft Gauge Division of Manning, Maxwell and Moore, Inc., Bridgeport, Conn. The use of plastics in making the dials has taken the place of aluminum and brass which are being used for national defense purposes.



The makers state that the plastic gage dial is superior to the metal dials, as it won't warp, corrode, rust or crack, also the face of the dial can be washed.

The dial graduations are jet black and permanently sealed between layers of clear plastic while the dial face is a glossless white.

Current Limiting Fuse Cutouts

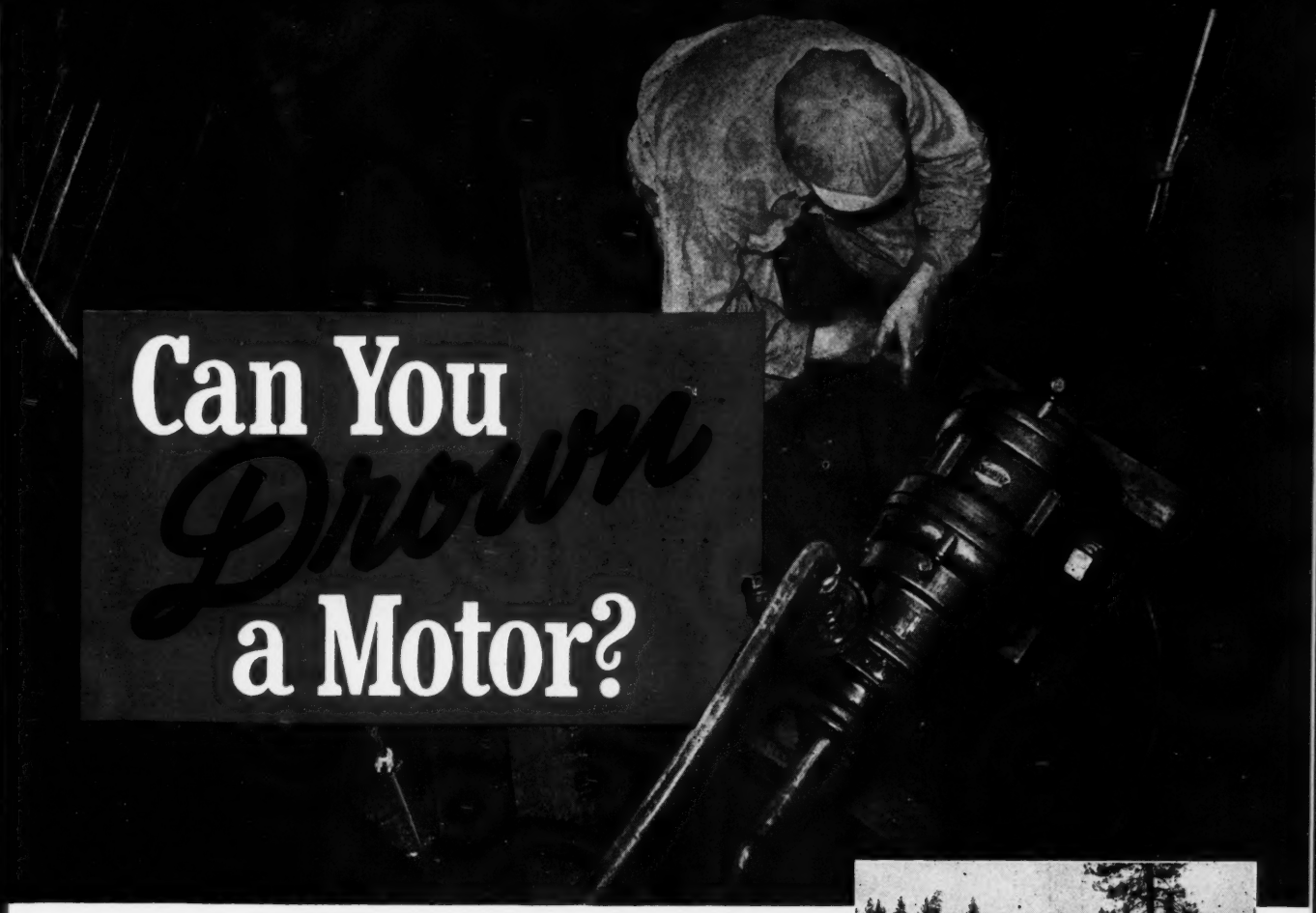
ANNOUNCED recently by the General Electric Co. are cutouts which combine current-limiting fuses with porcelain-enclosed housings used for distribution fuse cutouts of the nonindicating expulsion type.

These cutouts extend application of the enclosed housing idea to current-limiting fuses for potential and auxiliary transformers, and are of particular value in that capacity because of their great current-interrupting ability.

Wet-process porcelain cutout housings have proved in the last 12 years to be a highly reliable method of insulating fuse cutouts, and the mounting of the current-limiting fuse on the hinged doors provides a convenient form of disconnect switch. Complete enclosure of the fuse eliminates the danger of accidental contact. Mounting can be on a pole, pipe, crossarm, channel or other similar framework.

Porcelain cutout housings are available for use with Type EJ-1 Size A current-limiting fuse unit 1-1N amp. at 2500 v., 60 cycle with interrupting rating of 25,000 amp.; and Size B fuse units 1-1N to 3-3N amp. at 2500 v., 60 cycles, and 0.5-0.5N amp. at 5000 v., with 40,000 amp. interrupting capacity, and Size C fuse units from 1-1N to 40-25N amp. at 2500 v., 60 cycles, with 80,000 amp. interrupting capacity.

Recently announced by Fluid Meters, Inc., New York, N. Y., is the Vesta Fuel Oil Meter which is adapted to measuring the flow of fuel to Diesel engines. It is also of positive displacement design in order to give automatic record with a stated accuracy of ¼ to 1 per cent.



Can You *Drown* a Motor?

HOW MUCH punishment should a motor be able to take? This is an important question to motor buyers . . . for you never know when you'll need *extra* performance . . .

Take the case of the Western Molybdenum Corporation mine at Chewelah, Washington. They bought an Allis-Chalmers Pump powered by an Allis-Chalmers 10-hp Lo-Maintenance Motor.

Motor and pump were placed on a raft in a well. But due to an obstruction in the shaft, the floats stuck, and the motor operated under water for four days before it was noticed.

Then, to top it off—because the motor switch was still on when the water was lowered, the current ran through the exposed motor for 15 minutes more!

But—in spite of this terrific punishment, all that was needed was 24 hours of oven drying. Then the motor was hooked up... the switch turned on . . . and it purred into instant action. There was no additional repair cost . . . and today this motor is still giving 100% service!

For Lower Maintenance!

An exceptional case, certainly. In fact, we don't claim that Lo-Maintenance Motors are built for under-water operation. Nor will you probably ever demand this type of service. But it is your right to demand motors that cost a minimum of maintenance under *all normal operating conditions!*

That's the kind of low-cost, dependable performance Allis-Chalmers Lo-Maintenance Motors give you.

RUNNING FOUR DAYS UNDER water didn't stop a 10-hp Lo-Maintenance Motor located in a well pit of the Chewelah, Wash., mine of the Western Molybdenum Corporation.

It's performance based on full-measure, no-stint construction, distortionless stator, indestructible rotor, high carbon steel frame, and other extra-value engineering features.

Get the facts from the trained engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin.

A1392

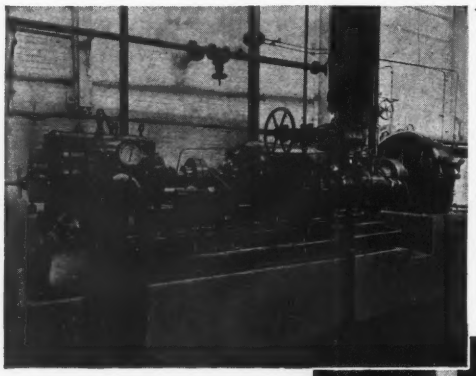
ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND UP

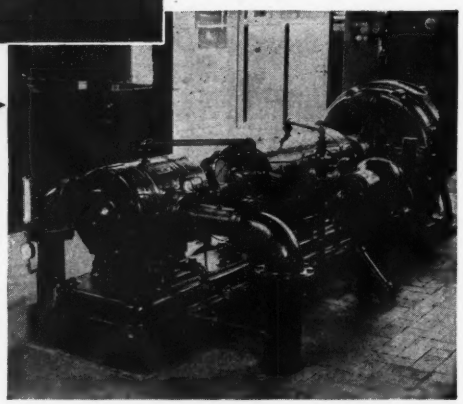
FOR PRESSURES TO 125-LB.

Fuller Rotary COMPRESSORS

Facts concerning Fullers . . . available for 80 to 125-lb. service. Performance records prove their worth.



Left: 1775 C.F.M. actual free-air delivery, 100-lb. pressure, Two-stage Rotary Compressor, installed in a plant in New York. This machine has had two comparatively long, 24-hr. per day runs. The first of these runs covered 5,668 hours and the second 12,144 hours, with the exception of less than an hour shut-down for inspection during the latter period. The remainder of the time it has operated approximately 16 hours per day whenever the plant has been in operation.



Right: 685 C.F.M. actual free-air delivery, 100-lb. pressure, Two-stage Rotary Compressor, installed in an eastern steel mill. As soon as this machine was installed it was placed on 24-hour a day service. So satisfactory was the performance of this unit that nine additional Fullers have since been installed.

Write for Bulletin C-3A

FULLER COMPANY

CATASAUQUA, PENNSYLVANIA

Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

C-48-A

FULLER

PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

MANUFACTURERS' PERSONALS

President of Wm. Powell Co.

JAMES COOMBE recently was elected President of The Wm. Powell Co., Cincinnati, Ohio, manufacturers of all types of valves. With the exception of 2½ yr., during which time he served over-seas as Captain of Artillery in the First World War, he has been associated with the company since his graduation from Yale in 1910.

The Wm. Powell Co. announces also election of Harry H. Coombe as Chairman of the Board of Directors and Treasurer; George E. Weitkamp as First Vice-President and Secretary; David M. Forker, Oliver F. Gang, Wm. E. Heilig, and E. R. Noll as Vice Presidents; and Wm. E. Minor, Jr., as Assistant to the President.

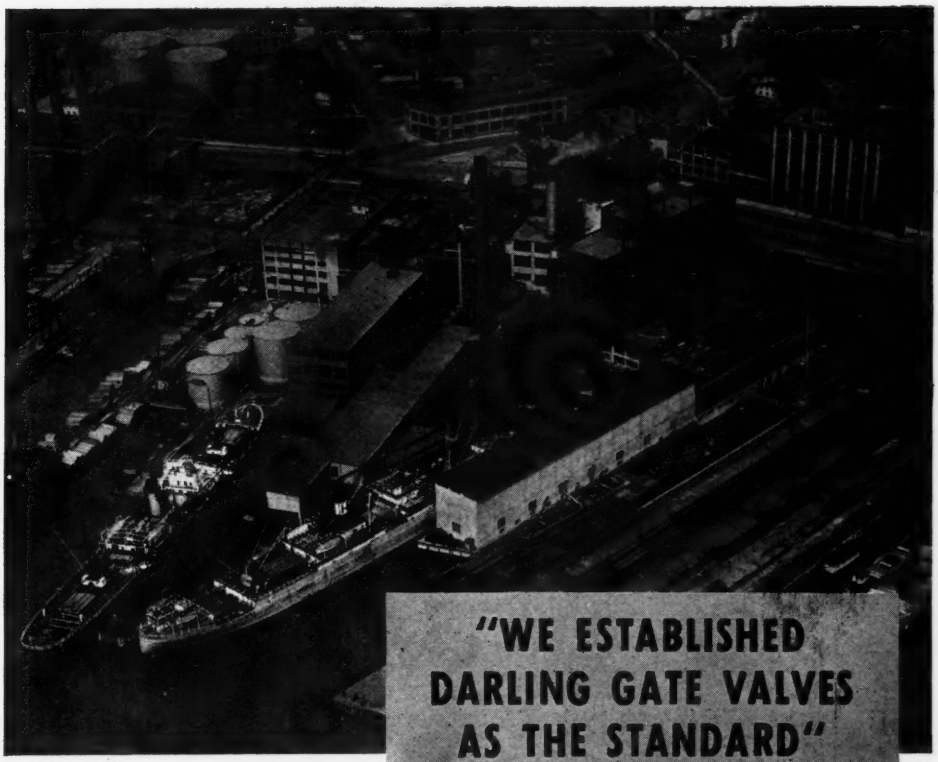
R. D. Yoder Transferred

R. D. YODER has been transferred from the Milwaukee headquarters of Cutler-Hammer, Inc., to its Cincinnati office. This addition of Mr. Yoder to the Cincinnati force is necessary, as stated by Mr. B. M. Horter, Sales Manager, to meet rapid increases in industrial activity and demand for C-H products in this area.

H. V. Erben, Manager G-E's Central Station

H. V. ERBEN, an assistant manager of the Central Station department of the General Electric Co. since January 1, 1939, has been appointed department manager, according to an announcement by E. O. Shreve, vice president. M. O. Troy, former manager, will continue as commercial vice president. The change was effective June 1.

Mr. Erben is a graduate of Yale's Sheffield Scientific School as mechanical engineer. He first was associated with General Electric in June 1917 but left in September for U. S. Army service as a second lieutenant of field artillery. He re-entered the company's employ in 1920.



"WE ESTABLISHED DARLING GATE VALVES AS THE STANDARD"

writes **Pennsylvania Sugar Co.**

"When we built our by-products plant in 1923, we established Darling Gate Valves as the standard," says Mr. Dan Gutleben, Engineer. "A good many have been operated several times per day for 16 years and are still performing effectively."

Darling Industrial Valve performance owes its reputation to better manufacturing methods from the very start. It begins with the unique Darling design—noted for its smooth curves and uniform sections. Careful foundry technique involves constant physical and chemical tests . . . plus accurate loading of the cupola . . . plus careful blending of molding sands. Texture and moisture content must be just right, with proper gating and heading. The resulting "dense metal" means better machining, more accurate threading, and freedom from flaws or shrink. See for yourself—specify Darlings for your next installation.

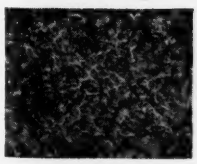
DARLING VALVE & MANUFACTURING CO.

Williamsport, Pa.

Representatives in:

New York Philadelphia Houston Toledo Pittsburgh
McPherson, Kan. Huntington, W. Va.

Photomicrograph (mag. 100x) showing the structure of a typical sample of cast iron as ordinarily produced. Note the entrained inclusions tending to break down the strength of the metal and produce leaks.



Shows the structure of Darling Dense Metal gray iron. In this dense, fine homogeneous grain structure the shrinkage porosity has been minimized, with resultant pressure tightness, strength and better resistance to abrasion and corrosion.

DARLING
DENSE-METAL GATE VALVES

Visibility

PLUS A PERFECT FIT

WHEN it comes to visibility, you can compare a PYREX Broad Red Line Gauge Glass with any other glass on the market. The results will speak for themselves.

And the accuracy of the gauge glasses you buy has a direct effect on gauge glass maintenance costs. All tubing from which PYREX and CORNING Gauge Glasses are made is machine drawn to uniform accuracy. Thus breakage due to installation strains is reduced to a very minimum.

Add to these important advantages, the relief from danger of breakage caused by sudden temperature shock, resistance to chemical attack and long life, and you have true gauge glass economy. PYREX and CORNING Gauge Glasses are stocked by leading mill and steam supply houses.

PYREX is a registered trade-mark and indicates manufacture by Corning Glass Works

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Today's Fight For Success

• •

To engineers, managers and stockholders of any manufacturing plant or service establishment, the power plant equipment makes up the weapons in today's battle for continuous and successful operation. In a large measure, it controls improvements, economies, dividends.

To gain success and move forward with the great power plant industry calls for a broadened knowledge on the part of operating engineers and managers in the value of the modern methods and equipment as described in the advertisements of this and other issues of POWER PLANT ENGINEERING.

Norman L. Deuble, formerly assistant to the vice-president, Copperweld Steel Co., Warren, O., has been appointed manager of sales. He is a graduate of the Case School of Applied Science with the degrees of B.S. and metallurgical engineer and is a member of both the A.S.M. and the S.A.E.

Dr. C. F. Rassweiler, since 1932 director of Dupont's Philadelphia Laboratory, has been appointed Director of Research of Johns-Manville Corp., as announced by Lewis H. Brown, president of the Corporation. Dr. Rassweiler is a graduate of the University of Denver and later secured masters degree in chemistry and in 1924 a Ph.D. from the University of Illinois. In his new position he will be a member of the Officers' Board, in charge of Johns-Manville's research activities with some 200 research men working on development of materials and processes.

A memorial to Col. A. F. Townsend, one of the founders of the Manhattan Rubber Mfg. Co., Passaic, N. J., and, before his death, its president for 26 yr., was recently dedicated in the presence of the 3600 employes whose contributions made the memorial possible. Surmounting a granite pedestal which carries a bronze bas-relief of Col. Townsend, is a 55 ft. bronze flagstaff. Inside the pedestal rest his ashes, with papers and memorials. The monument was inveiled by Constance Vogel, a niece of Col. Townsend, while the ten oldest employees, as a guard of honor raised the flag on the staff.

Thomas W. Rolph was recently elected vice-president of the Holophane Co., New York, City. He first joined the Holophane organization after graduation from Cornell University in 1907 with the degree of electrical engineer; in 1921 became managing engineer of the street lighting department; in 1928 was appointed assistant chief engineer; and in 1931 was appointed chief engineer. In February, 1940, he was awarded a plaque by the N.A.M. naming him a modern pioneer of the frontier of American industry.

Announcement is made by Manning, Maxwell & Moore, Inc., Bridgeport, Conn., of the following changes in its sales force; C. G. Tyler, formerly with railroad division in the Chicago District takes over the industrial division for the Columbus, O., territory; Arthur B. Bleecker, formerly with Creamery Mfg. Co. at Los Angeles will represent all four divisions in the Portland, Seattle and other Pacific northwestern territories; Win Adams is transferred from Columbus, O., to the Buffalo, territory.

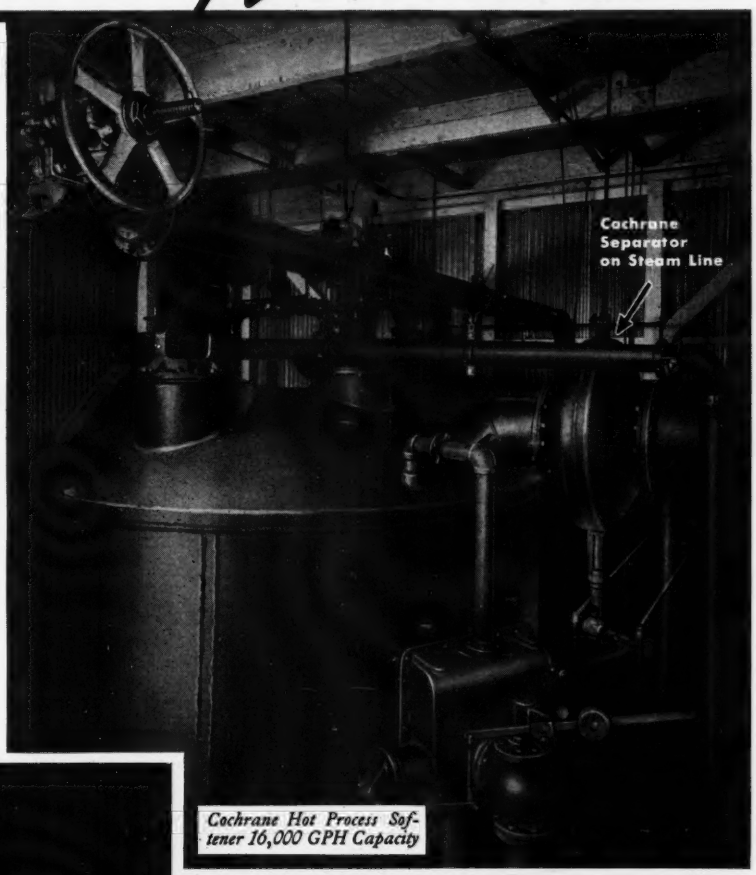
American Engineering Co., Philadelphia, Pa., announces the following appointments of representatives for Lo-Hed Hoists: George C. Lever Co., 50 Church St., New York City and 972 Broad St., Newark, N. J., for the territory of northern New Jersey, Greater New York and Long Island (replacing A. C. Cooper); George J. Sturmfelsz, 1208 Southview Road, Baltimore, Md., for the state of Maryland; H. E. Mensch, 424 Book Bldg., Detroit, Mich., for the Detroit territory, and American Steel Export Co., 347 Madison Ave., New York City, as foreign sales representative in certain foreign markets.

Water Conditioning for Textile Mill

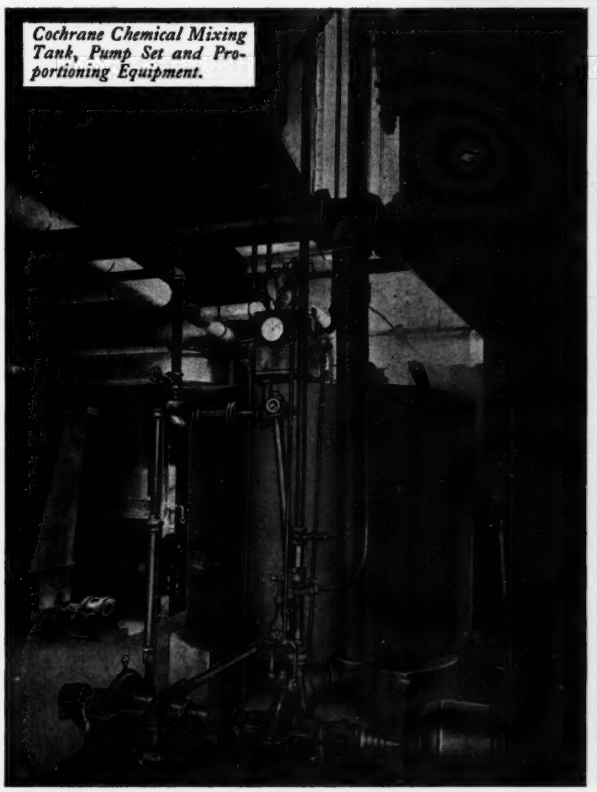
A Cochrane-equipped Plant

THE textile industry is probably more familiar with the problems of water treatment than most other industries. So when the textile company, whose equipment is illustrated here, were ready to select apparatus for the treatment of the feed-water for their power plant, their choice of Cochrane Hot Process Softener, with filters, chemical proportioners, pumps, etc., had special significance. A Cochrane steam separator and Cochrane temperature recorder complete the list of Cochrane equipment in this installation, and indicate the wide range of power plant apparatus available under the Cochrane name.

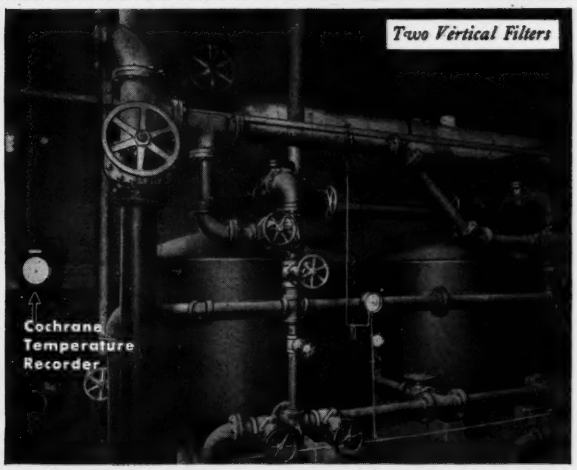
COCHRANE CORPORATION
3123 N. 17th St., Philadelphia, Pa.



Cochrane Hot Process Softener 16,000 GPH Capacity



Cochrane Chemical Mixing Tank, Pump Set and Proportioning Equipment.

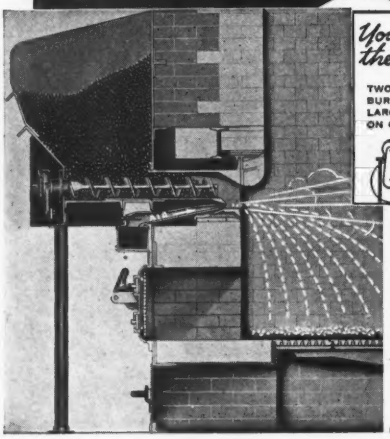


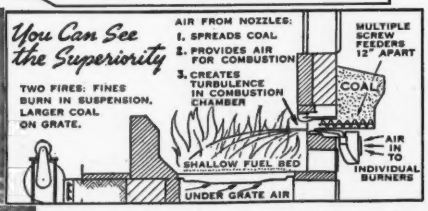
Cochrane
WATER CONDITIONING

Use this- "✓CHECK CHART for Stoker Buyers"

Features You Want:	FYR-FEEDER:
1. MODERN FIRING METHOD	✓ The FYR-FEEDER is the newest type of spreader stoker, which in turn is the latest development in coal firing equipment. Burns cheapest coal, thereby reducing coal bills. Excellent results with wet or dry coal. Users report savings up to as much as $4.00 per ton by using local screenings, yard sweepings, etc.
2. SIMPLE CONSTRUCTION	✓ The FYR-FEEDER is the simplest spreader stoker built. (See accompanying sketch.) No steam jackets, no water jackets, no high pressure fans, no furnace gases needed to dry coal before firing, no high speed moving parts in contact with coal or exposed to radiant heat of furnace. Compare FYR-FEEDER'S neat, compact, streamlined appearance with conventional bulky, exposed stoker designs.
3. DEPENDABLE PERFORMANCE	✓ Even in small FYR-FEEDER units, users get the dependability of two, four, or more, independent burners. No trouble with clogging due to wet or damp coal. Virtually immune to damage from any source.
4. HIGH FIRING EFFICIENCY	✓ Ability to follow fluctuating loads closely . . . use of a thin fire bed . . . excellent turbulence in furnace, all make for high average efficiency.
5. LOW OPERATING COST	✓ Power requirements for the FYR-FEEDER are very low. Little attention or supervision is required. Fireman's work is made easy because operation is automatic.
6. QUALITY CONSTRUCTION	✓ Fine grained semi-steel castings, precision cut gears, modern streamlined steel plate work all contribute to a standard of quality second to none. Assembly includes finest motors, fans, controls, etc., obtainable.
7. RELIABLE ENGINEERING	✓ More than 23 years of successful combustion engineering experience in engineering and building thousands of overfeed stokers stand back of the FYR-FEEDER. A drawing is made for each installation by our Engineering Department.
8. MAXIMUM RETURN ON INVESTMENT	✓ The FYR-FEEDER has repeatedly demonstrated its ability to pay the highest return available. We will be glad to submit a proposal on your requirements. Write or use coupon below.

Fyr-Feeder Multi-Burner




You Can See the Superiority
AIR FROM NOZZLES:
1. SPREADS COAL
2. PROVIDES AIR FOR COMBUSTION
3. CREATES TURBULENCE IN COMBUSTION CHAMBER
MULTIPLE SCREW FEEDERS 12" APART
TWO FIRES: FINES BURN IN SUSPENSION. LARGER COAL ON GRATE.
COAL
AIR IN TO INDIVIDUAL BURNERS
SHALLOW FUEL BED
UNDER GRATE AIR

Each FYR-FEEDER has 2, or 4, or more burner spreaders.

AMERICAN COAL BURNER CO.
153 E. Superior St., Chicago, Ill.
☐ Please mail descriptive literature.
☐ Quote me cost estimates on a FYR-FEEDER for a .....h.p. boiler.
☐ Have Salesman call.

Name .....
Company .....
Address .....

Sherman Barnes, in charge of the western New York territory for Ampco Metal, Inc., Milwaukee, Wis., has established new headquarters at 699 Potomac Ave., Buffalo, N. Y.

R. M. Cleveland, for 24 yr. with Worthington Pump and Machinery Corp., has been appointed manager of its Boston office, succeeding W. A. Finn who has been called to active duty with the Navy.

Ralph K. Davies, director and senior vice-president, Standard Oil Co. of Calif., has been appointed deputy coordinator of petroleum oil. He is also president of Stanard Oil Co. of British Columbia; a vice-president of Standard Oil Co. of Texas; a director of the California Pipe Line Co.; and president of Standard Stations, Inc.

Harry W. Smith, Jr., formerly director of industrial publicity of the American Gas Association, is now advertising manager of The Selas Co. of Philadelphia, specializing in industrial process heating. The change was made July 1.

Morris Machine Works, Baldwinsville, N. Y., announces the appointment of L. J. Lynch as its new representative in the Detroit office, located at 403 Kales Bldg.

Ray J. Thompson, eastern district manager of Ampco Metal, Inc., Milwaukee, Wis., has changed his address to 57 White Ave., West Hartford, Conn., from where he will supervise Ampco field offices at Springfield, Mass., New York City, Philadelphia, and Washington, D. C.

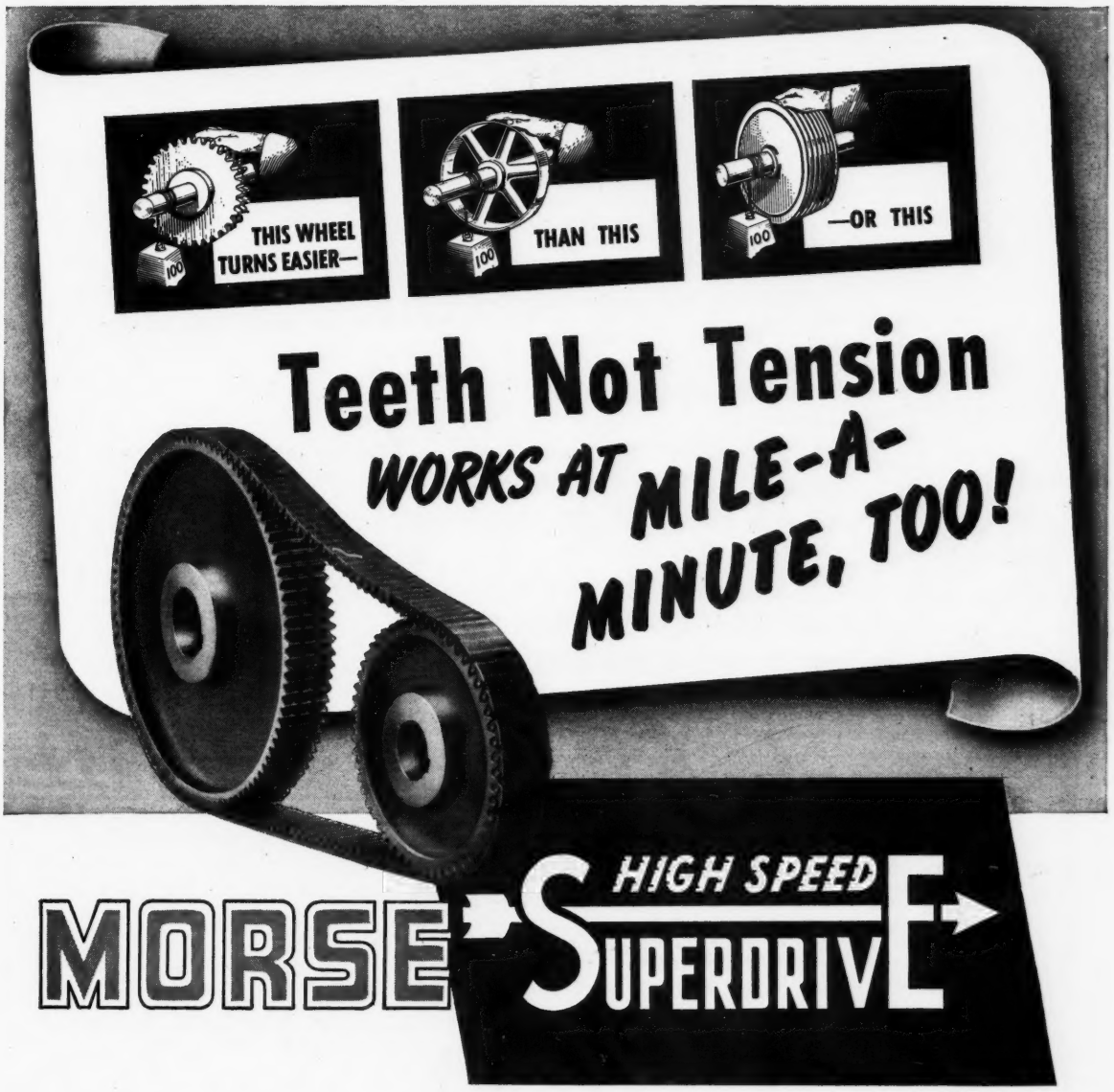
Herbert J. Braun, formerly with Foote Bros. Gear and Machine Corp., Chicago, Ill., has been appointed Detroit sales representative for the McKenna Metals Co., Latrobe, Pa. His offices are at 14425 Mark Twain Ave., Detroit, Mich., where John S. Roney is in charge.

W. C. Pinkerton, for 6 yr. assistant technical editor of Chemical Engineering Catalog, has joined the Monel and Rolled Nickel Advertising Dept. of International Nickel Co. to handle technical material for process industries and edit house publications for those industries.

William A. Marsteller has been appointed advertising and sales promotion manager of The Edward Valve & Manufacturing Co., Inc., East Chicago, Ind., after 9 yr. of newspaper, advertising, and sales experience in Champaign, Ill., and Chicago.

Directors of the Union Carbide and Carbon Corp., have elected Jesse J. Ricks, president since 1925, as chairman of the board. Benjamin O'Shea, formerly vice-president since 1925, was named as the new president. James A. Rafferty, a vice-president, was elected to the board of directors and Robert W. White, secretary and treasurer, was elected a vice-president.

Timken Roller Bearing Co. announces a number of personnel changes, C. M. Maratta, maintenance engineer since 1921, was promoted to Chief Works Engineer; Walter F. Green becoming Assistant Works Engineer; and



IN THE Morse High Speed Superdrive, you get all the advantages of silent chain drives—strength, flexibility, positive efficiency, low maintenance cost, adaptability—plus very important advantages which belong exclusively to the High Speed Superdrives.

Superdrives achieve chain speeds of a mile-a-minute and more with the same motor r.p.m.'s, through the use of larger sprockets with more teeth. The added speed of the chain accomplishes remarkable results. Power transmitting capacity of the drive rises rapidly—even faster than the speed of the chain increases. Centrifugal force goes to work *for* the drive, spreading stresses thin and evenly over the teeth of chain and sprocket, resulting in smooth, quiet operation in which wear is so small that it can scarcely be measured.

And because the capacity is increased so sharply, Morse High Speed Superdrives can be amazingly compact. On a recent drive, the Superdrive engineered design called for chain ⅓ the width which conventional low-speed drive design would have recommended!

Here's a drive for high-speed operation which has plenty to offer. It's compact, efficient, long-lived, economical to operate, costs no more than other types of high-speed drives. Get complete information on Morse High Speed Superdrives from the Morse man near you, or write direct to Morse, Ithaca.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

Putney L. Wright, Plant Engineer. On the sales staff, Harry McColl, Jr., who worked in tube production from 1928 until March, 1941, has been appointed southwestern sales representative for the states of Kan., La., Okla., Ark. and Tex., with headquarters at Dallas, Tex.

Falk Corp., Milwaukee, Wis., announces the appointment of W. L. Schneider as vice-president of sales, T. F. Scannell as sales manager and J. B. Kelley as assistant sales manager. Mr. Schneider, while fulfilling his new duties as a vice-president will continue in the supervisory capacity as director of sales. Mr. Scannell will be responsible for the active sales of all Falk products, except those under the jurisdiction of the Foundry Div. Mr. Kelley who has been with the Falk Corp. since 1927 as estimator, salesman, and district manager, has been in recent years in charge of the flexible coupling business.

Leslie S. Gillette, of the Chicago Pneumatic Tool Co., was re-elected president of the New York Sales Managers' Club for a second term on June 12. This is the oldest organization of its kind in the country, being founded June 23, 1916.

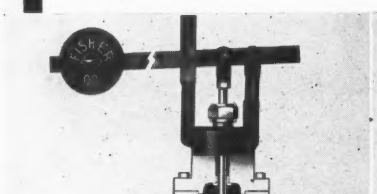
FISHER

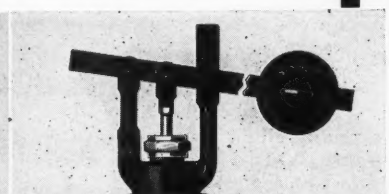
ALL PURPOSE LEVER VALVES
FOR GENERAL FLOW CONTROL SERVICE
IN POWER AND INDUSTRIAL PLANTS

FISHER SERIES 7 Lever Valves insure outstanding flow control of steam, water, oil, gas and other fluids under all temperature and pressure conditions both to and from evaporators, standpipes, tanks, reservoirs, vats, etc. They are designed for operation by some auxiliary force such as might be supplied by float units, combustion controls, electric motors, diaphragm motors, and similar devices and are often remotely located from the motivating force.

Various designs are available in a complete range of sizes and for all service conditions. All designs are standard construction, but every valve is "custom-built" and actually tested for the working conditions specified. Metals best suited for the fluid being handled and for temperature and pressure encountered are carefully selected for body and trim.

Lever and yoke can be turned to any desirable angle with relation to the body, and weight and lever easily changed to reverse the action of the inner valve.





TYPE 7:

Bronze, high-tensile iron, or cast steel bodies . . . angle or globe types . . . single or double port; with quick opening, V-port throttling, needle point, or top and bottom guided throttle plug inner valve of bronze, nickel iron or stainless steel. Available in ½" to 3" screwed bodies and ¾" to 10" flanged bodies for pressures up to 600 lbs., 750 degrees or 1000 lbs., 100 degrees F.

TYPE 7H:

Recommended for high pressure service and extreme pressure drops with comparatively small volumes. Suitable for initial pressures up to 1500 lbs. at 450 degrees F. Forged steel body—globe pattern only; with needle point inner valve and renewable screwed-in seat ring of stainless steel; available in ½" to 2" screwed bodies and 1" to 2" series 600 lbs. and 1500 lbs. flanged bodies.

FISHER GOVERNOR COMPANY
1003 FISHER BUILDING
MARSHALLTOWN, IOWA

Co-ordinate Engineering and Research

DEFENSE PRODUCTION and design will be speeded by six executive assignments co-ordinating the engineering and research departments at the Westinghouse Company as well as by two new positions: a manager of the headquarters engineering departments; and an assistant director of research. This new organization set up will permit a more rapid interchange of research and development engineering experience, focusing on the paramount problem of developing and designing new apparatus, processes and equipment to aid the defense expansion of the Nation's industries.

C. A. Powel was named manager of the headquarters engineering departments, and H. W. Tenney was appointed assistant director of research. As executive chief of the headquarters engineering departments, Mr. Powel, an engineer of international experience and reputation, assumes control over the industry engineering department, the engineering laboratories and standards department the foreign engineering department and the engineering association activities.

The other appointments include: A. C. Monteith, manager of the industry engineering department, succeeds Mr. Powel. This department performs a unique function, serving as a "clinic" to make it easier for engineers in various fields to obtain from it latest engineering developments affecting their industries.

C. F. Wagner, manager of the central station engineering department, succeeds Mr. Monteith. This department handles the many system problems incident to the application of equipment for the generation, transmission, and distribution of power.

Mr. R. E. Hellmund as chief engineer, with his staff, will continue to head a consulting service to all engineering groups. Also, he has the additional assignment of establishing close contact with and assisting in research, especially with the view of promoting and coordinating more effectively research work for the engineering departments.

Mr. Tenney, as assistant director of research, assumes responsibility for the business administration of the Westinghouse Research Laboratories as well as the progress and completion of research development programs and projects. He will report to Dr. L. W. Chubb, director of research.

Thomas Spooner, formerly manager of the Westinghouse Research Laboratories, was named manager of the engineering laboratories and standards department, a dual post entailing supervision over numerous engineering laboratory units and over the department that prepares specifications for materials and processes.

Elliott Co. Changes

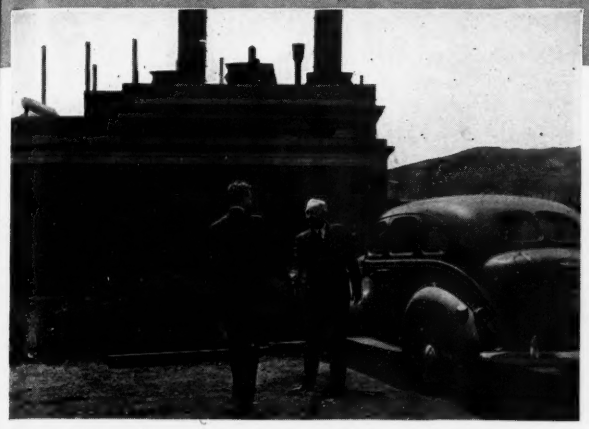
RECENT CHANGES in the general office and sales organization of Elliott Co., Jeannette, Pa., include the following:

L. M. Forncrook, who has been a company vice-president and manager of the Jeannette plant, is now vice-president in charge of operations with responsibility for manufacturing operations at the plants in Jeannette, Pa., Ridgway, Pa., and Springfield, O.

V. H. Peterson, who has been general sales manager, has been elected a vice-president responsible for the operation

The Mystery of the Missing Vent

Inlet end tube failure faced this coast power plant. From investigations, failure was apparently due to air being entrained in the circulating water. Plant blue-prints, however, provided no clue to this. A new and more expensive alloy seemed indicated.



MEN *A Scovill engineer* was called in to investigate. He suspected an air-bound inlet circulating water tunnel . . . and down near tide level, he found the answer.

A small vent plugged by an unusually high tide! Removing the plug and installing a new, higher vent were the only changes recommended. Result: tripled tube life, without the cost of new tubing.

METALS A complete follow-up, by Scovill research, in this case, testing the water and examining metals, established that the plugged vent alone caused the trouble. No more worry!

MANUALS *In black and white* . . . into a Scovill manual goes another addition to the practical solution of Condenser Tube problems.

SCOVILL'S SOLUTION OF A SIMILAR PROBLEM MAY SAVE YOU TIME AND MONEY

Tube life tripled—yes, but not by buying a new, expensive alloy. For this customer, Scovill's 3 services — in *men, metals,* and *manuals* — saved time and money merely by recommending a minor construction change.

Your next problem may be different . . . involving an installation change, or a new alloy evolved in Scovill's laboratories. Or perhaps Scovill's complete "Condenser Tube Booklet" already answers your questions about condenser or heat exchanger tubes. Write for it today! No obligation. Address Scovill Mfg. Co., 17 Mill Street, Waterbury, Connecticut.

SCOVILL CONDENSER TUBES

one product . . . three services

- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

Scovill, for many years a regular source of supply for the U. S. Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable and part of the price paid for national defense.

Scovill

MANUFACTURING COMPANY

WATERBURY, CONN.

★ SPECIFY-ERNST ★

LEAKLESS COCKS

HAVE YOUR BOILERS EQUIPPED WITH

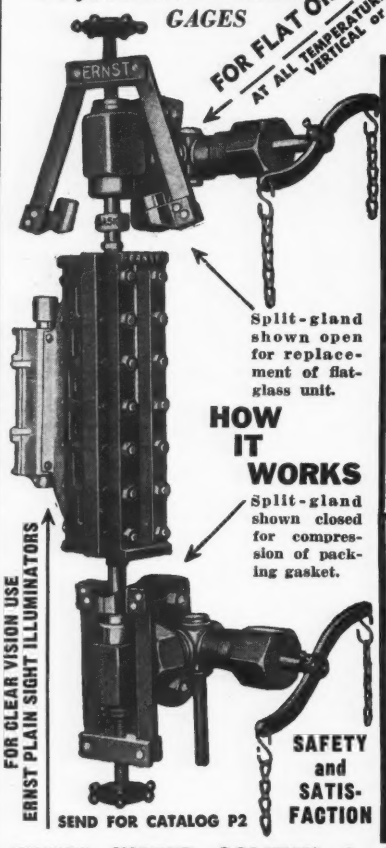
"SPLIT-GLAND"

ADJUSTABLE WATER GAGES

FOR FLAT OR ROUND GLASSES AT ALL TEMPERATURES AND PRESSURES VERTICAL or INCLINED

MADE TO FIT ANY WATER COLUMN OR BOILER

CAN BE ATTACHED TO ANY WATER COLUMN OR BOILER
ALIGNMENT AND STIFFENER ROD
NO GAGE GLASS PACKING NUTS
GLASS CAN BE SET AT ANY ANGLE OR VERTICAL



Split-gland shown open for replacement of flat-glass unit.

HOW IT WORKS

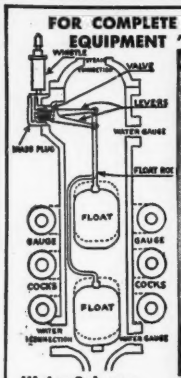
Split-gland shown closed for compression of packing gasket.

FOR CLEAR VISION USE ERNST PLAIN SIGHT ILLUMINATORS

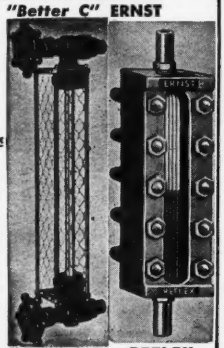
SEND FOR CATALOG P2

SAFETY and SATISFACTION

FOR COMPLETE WATER COLUMN EQUIPMENT "Better C" ERNST



Water Columns Forged Steel For All Pressures



Wire Glass "Better C" Guards

REFLEX "C-Black" Glass Inserts

High pressure and temperature Gage Glass Gaskets—"They Won't Blow Out."

ROUND - TUBULAR GLASSES for High Pressure Service — Clear or Red Line Magnifying.

CLEAR & REFLEX GLASSES, all sizes

ERNST WATER COLUMN & GAGE CO., LIVINGSTON, N. J.

DISTRICT OFFICES: NEW YORK · INDIANAPOLIS · CHICAGO · LOUISVILLE · PITTSBURGH
DENVER · TULSA · HOUSTON · DETROIT · CLEVELAND · LOS ANGELES

A Plus Service For Engineers

Backing up their regular advertisements in POWER PLANT ENGINEERING, many manufacturers have prepared special catalogs and bulletins describing in greater detail the construction, installation and operation of their equipment. This literature is up-to-the-minute and frequently contains engineering data not available elsewhere.

Should you desire a catalog or specific information regarding power plant equipment, we will gladly get it for you from the manufacturer. Let us know also if you are interested in any particular piece of equipment, such as a pump, compressor, motor, fan, superheater, and we will get useful data for you on the different makes. Just write our Reader Service Department.

of the district sales offices, including all sales, advertising and service activities of the three plants.

L. E. Nohl, who has been a member of the Board and of the Executive Committee, has been elected a vice-president and will be responsible for all financial and accounting functions.

W. A. Elliott, who has been a member of the Board and of the Executive Committee, and for the past 1½ yr. manager of the Chicago district office, is now a vice-president and will be responsible for market research, field studies, and the administration of purchasing.

M. A. King, for the past 9 yr. manager of the turbine department, and, previous to that, chief engineer of the turbine department, has been appointed manager of engineering with responsibility for engineering, design, and drafting of all products built in the three Elliott plants.

J. R. McDermet continues as chief engineer, with particular responsibility for product research and development, patent work, metallurgy, and material specifications.

W. E. Widau has been appointed Chicago district manager. He has been Kansas City manager since 1928 and will be succeeded there by J. N. McClure from the Tulsa subdistrict office. L. A. Kunzler will remain in the Tulsa office.

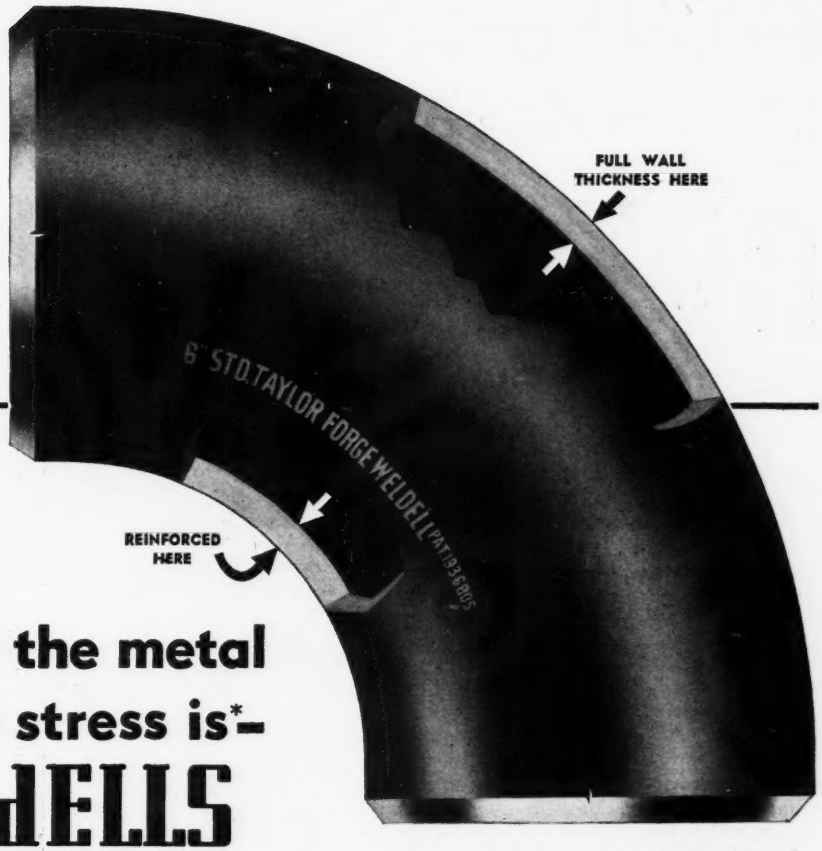
W. A. Yost, formerly assistant manager, will be manager of the turbine sales department. R. N. Williams will become manager of the blower sales department. J. P. Stewart has been named manager of the newly created supercharger sales department which will handle turbo-chargers and blowers for Diesel application.

Haering Personnel

CHANGES IN PERSONNEL are announced by D. W. Haering & Co., Inc., Chicago, Ill., as follows: E. H. Snyder is in charge of a new district office at 726 Electric Bldg., Houston, Tex.; C. E. Erb is now district manager at 557 W. Douglas St., Wichita, Kan.; S. R. Long will have headquarters at 1108 N. 12th St., Waco, Tex.; Gray I. Thomas has offices at 2423 Caroline St., Dallas, Tex.; Harry McLear will be in charge of a new office at Evansville, Ind.; N. D. Russell recently added to the sales staff will be located at 208 E. Main St., Pomeroy, O.; John Daggett recently joined the chemists' staff at the Chicago Laboratories; Dr. A. R. Swanson and Lt. W. H. Creighton are loaned to the Government for work at Washington, D. C., in the Defense program, the former as expert in charge of smokeless powder, the latter with the Navy.

MANUFACTURERS' NEWS

In a plan to promote cordial relationship between employees and management of the Allis-Chalmers Mfg. Co., Max W. Babb, president, has announced that Lee H. Hill, was elected vice-president at the annual meeting of directors May 9, will head up a newly created Industrial Relations Department. In his new capacity, Mr. Hill, formerly assistant manager of the electrical department, will be in charge of collective bargaining, grievance procedure, employment, wage policies and levels and all other sub-



You'll find the metal where the stress is*— in WeldELLS

IT'S a matter of common knowledge that the bursting stresses in an elbow are *higher* at the crotch*. So to have *full* strength and *uniform* strength, selective reinforcement of this region is absolutely essential. The illustration above shows how this needed reinforcement is provided in WeldELLS.

It calls for good engineering and carefully controlled manufacturing procedure to provide the added value of selective reinforcement for users of WeldELLS. But this feature, like the others listed opposite, is just one more example of the principles that have guided Taylor Forge for more than 40 years: *First, sound engineering design; then maximum utility, convenience, and economy.*

Here again is an *extra-value* that costs you nothing. For in spite of their premium quality, WeldELLS and other Taylor Forge Fittings *cost no more!*

You'll find our 216 page catalog crammed full of useful information and engineering data. If you use, buy, or specify welding fittings or forged steel flanges, write for it today.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

OTHER *Extra-Value* FEATURES

You can't ask for a single thing in welding fittings that Weldells do not have. No other fittings for pipe welding combine these eight features. In addition to selective reinforcement, the features are:

1. Seamless—greater strength and uniformity.

2. Tangents—keep weld away from zone of highest stress—simplify lining up.

3. Precision quarter-marked ends—simplify layout and help insure accuracy.

4. Permanent and complete identification marking†—saves time and eliminates errors in shop and field.

5. Wall thickness never less than specification minimum—assures full strength and long life.

6. Machine tool beveled ends—provides best welding surface and accurate bevel and land.

7. The most complete line of Welding Fittings and Forged Steel Flanges in the World—insures complete service and undivided responsibility.

†Since the marking is pressed into the metal before forming, and since the manufacture of the fittings is carried out at a forging temperature, each in effect receives a heat treatment after the operation. The indentations have no sharp corners or edges and the marking has no effect on the strength of the fitting.

* The amount by which stress is greater at the crotch in a fitting having uniform wall thickness depends only on its radius. Mathematical analysis (specifically the Lorenz formula) shows the stress at the crotch to be:

$$S = \frac{pr}{2t} \frac{(2R - r)}{(R - r)}$$

Where S = Bursting stress, lbs. per sq. in.
p = Internal pressure, lbs. per sq. in.
r = ½ inside diameter of fitting (O.D. if Barlow's formula is desired).
t = Wall thickness in inches.
R = Center line radius of fitting, inches.

Numerous tests by the Research Division of Taylor Forge show the formula given above to be somewhat on the conservative side.

The Less Time You Have to Clean Tubes, the More You Need the New

ROTO
TUBE CLEANERS

Standby tubular equipment is being pressed into service to help meet the urgent power demands of the defense program. Now, more than ever, down time is costly, and increased fuel costs make clean tubes pay bigger dividends.

The new Roto Tube Cleaner will help put your boilers, condensers and heat exchangers back into service much faster than ever before possible. The rugged, dependable Roto motor gives you greatly increased speed and power to remove scale. An air valve on the motor gives your operator full control of the cleaner, eliminating his need for a helper, and saving the time formerly wasted in signalling every time the cleaner had to be withdrawn from one tube and inserted into the next.

The superior results and time and labor saving features of the new Roto make it unprofitable to continue using old fashioned tube cleaners. Let us prove it.

Rapid Action Air Valve
Permits One-man Operation

SEE OUR ADV. IN SWEET'S AND WRITE

The ROTO Company

145 Sussex Avenue - Newark, N. J.

Change of Address

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

jects which bear on management-employe relations.

York Ice Mach. Corp. has transferred its Export Division personnel from Brooklyn, N. Y., to the main factory offices at York, Pa., in order to provide direct factory assistance for its foreign representatives.

Directors of Builders Iron Foundry, Providence, R. I., announced, effective May 1, 1941, that the company will conduct its metering business under the name of Builders-Providence, Inc. This is a change of name only, since Builders-Providence, Inc., is a division of Builders Iron Foundry and has the same directors and officers. Started in 1820, as a foundry to supply cast iron columns and miscellaneous cast iron hardware, a machine shop was added later. It acquired exclusive manufacturing rights for the Venturi meter in 1887 and now offers a complete line of precision instruments.

Paragon Electric Co. has moved its manufacturing facilities from Manitowoc to Two Rivers, Wis., where it will occupy a modern brick and concrete building having over 25,000 sq. ft. of floor space. Executive headquarters will remain in Chicago at 37 West Van Buren St.

Quimby Pump Co., Inc., Newark, N. J., will have five times the 1940 factory capacity when a new building, with 22,000 sq. ft. of area is completed and in production late in 1941. The new factory is located at New Brunswick, N. J.

Purchase, by Warren Webster & Co., Camden, N. J, of the Ross expansion joint business from the Ross Heater & Mfg. Co., Inc., of Buffalo, N. Y., a division of American Radiator & Standard Sanitary Corp., has recently been announced. The Ross Co. has disposed only of the expansion joint business and is continuing with all of its other lines. With this addition to its products, Warren Webster & Co. has a complete line of semi-guided, crosshead guided and internally guided expansion joints to supplement its previous line of conventional Webster expansion joints. The Rossite expansion joint lubricating system is also included in the Webster acquisition.

Eye-Hye Gage No. 1000 was recently shipped to Union Electric Co.'s Venice No. 2 plant at Venice, Ill., after a personal inspection by J. Rowland Brown, inventor and president of the Reliance Gauge Column Co. of Cleveland. With Eye-Hye No. 1000 were shipped three others of identical capacity for use on the 900-lb. Combustion Engineering Co. boilers at Venice where E. H. Tenney is Chief Engineer of the Union Electric Co.

Forty-seven years in service is the record of two General Electric generators, in San Francisco railway plants. They have their original bearings, commutators and fields; a spare armature and commutator, furnished with the machines when shipped, have never been used. They are for 500 v., 340 amp. at 475 r.p.m. Originally they were in the Bryant St. station of the Market St. Ry. Co. and belt-driven from Ball engines. After the fire, they were moved to operate the Castro St. cable road as motors, and are now retired, as the cable road is converted into a bus route.

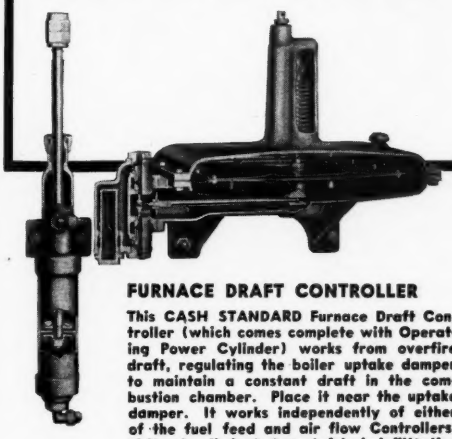
BOOST BOILER ROOM *Performance*

AND CUT OPERATING COSTS IN DOING IT ! ! !

CASH STANDARD

AUTOMATIC COMBUSTION CONTROL

is not a costly investment



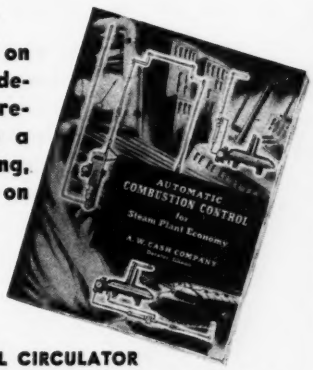
Get the most out of your boiler room by applying CASH STANDARD Automatic Combustion Control — make such important savings as in fuel costs and in maintenance — get more steam even though you burn less fuel — hold your steam pressure within close limits — get dependable boiler room control that saves detail on the part of operators and gives them more time to do other important duties.

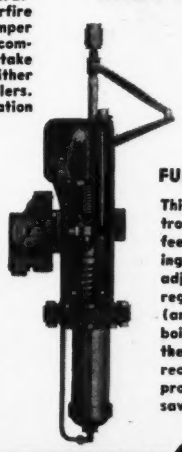
There are numerous types of CASH STANDARD Systems of Automatic Combustion Control. They are varied according to the necessities of plant requirements. Regardless of the kind of fuel you burn or the size or type of your boiler or furnace, you can secure a dependable CASH STANDARD Automatic Combustion Control System to give you lower boiler room operating costs. Units for a complete system can be purchased for as little as $290.

FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber. Place it near the uptake damper. It works independently of either of the fuel feed and air flow Controllers. If it only eliminated wasteful air infiltration it would be a profitable investment.

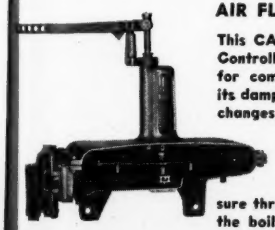
Read in Bulletin No. 300 complete details on CASH STANDARD systems specifically designed to meet every requirement — whether you have a stoker, pulverizer, oil-burning, or gas-firing equipment on your boiler.





FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

OIL CIRCULATOR

The purchase of this oil circulator is optional. All three Controllers shown above can be properly operated by clean water, but it is preferable and cheapest in the long run to operate with this CASH STANDARD Oil Circulator — price $108. equipped with 110-220 v. 60 cy. motor.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

NICHOLSON

A Good Name To Remember When You Buy

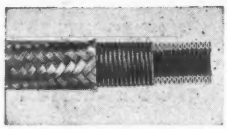
FLOATS
•
INDUSTRIAL STEAM TRAPS
•
COMPRESSED AIR TRAPS
•
FLEXIBLE COUPLINGS
•
STEAM SEPARATORS
•
CONTROL VALVES

Write Today for Illustrated Bulletins

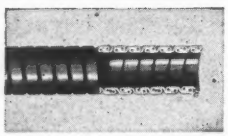
W. H. NICHOLSON & CO. 160 Oregon St., Wilkes-Barre, Pa.

NEW BULLETINS POINT WAY

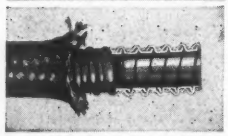
To Trouble-free Service with FLEXIBLE Pipe



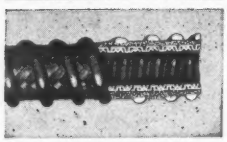
1 PENFLEX-WELD is the new corrugated jointless tubing for all services where leaks are fatal. In steel or bronze. See Bulletin 90.



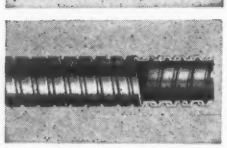
2 PENFLEX 4-WALL INTERLOCKED, pioneer of flexible safety, described in Bulletins 52 and 59. Tank Car, Bulletin 55; and Marine, Bulletin 58.



3 PENFLEX HIGH RIDGE is a medium duty type offering many possibilities to ingenious designers: Bulletins 52 and 59.



4 PENFLEX EXTRA-FLEX has greatest flexibility consistent with safety: Write for Bulletins 52 and 59.



5 PENFLEX LIGHTWEIGHT is widely used for conduits, conveying light material, vent ducts, spouts, etc. Bulletin 60.

PENFLEX

Tight as Pipe . . . but Flexible

Pennsylvania Flexible Metallic Tubing Co.

7207 Powers Lane, Philadelphia, Pa.

NEWS FROM THE FIELD

Warren Gilman Jones, President of the W. A. Jones Foundry & Machine Co., Chicago, succumbed to a heart attack at his home in River Forest, Ill., June 6. Mr. Jones was well known in industrial and engineering circles. He was born in Chicago in 1890, entered his father's firm in 1910, and since 1925 had been President. He was also Vice-President of the Sackett Screen & Chute Co. of Chicago. Warren G., Jr., and Thomas A. Jones, his sons, are connected with W. A. Jones Foundry & Machine Co.

Annual Convention of the Smoke Prevention Assn. of America at Atlanta elected the following officers: H. K. Kugel, Washington, D. C., president; W. E. E. Koepler, Bluefield, W. Va., 1st vice-president; Frank A. Chambers, Chicago, Ill., secretary-treasurer; Andrew Jones, Atlanta, Ga., sergeant at arms. Cleveland, Ohio, was selected as convention city for the 1942 meeting, dates to be announced later.

Charles F. Roth, manager of the Chemical Industries Exposition to be held in Grand Central Palace, New York, Dec. 1-6, reports that with the show 6 mo. away, 95 per cent of the space has already been engaged. No display in the last 12 yr. has equaled this advance allotment. The 40,000 attendance at the show 2 yr. ago is expected to be far outdistanced this year.

Electro Metallurgical Co. has applied to the Federal Power Commission for license to increase is hydro-electric plant on the New River, W. Va., to 175,000 hp., and to add 5 ft. to the height of the crest gates on the dam and to excavate the tailrace so as to increase the head about 10 ft.

G. E. Dahlberg, Chairman of the Combustion Class Committee of the Chief Engineers' Association of Chicago, Room 1202, 185 N. Wabash Ave., announces that because of the importance of fuel and combustion engineering in connection with national defense, they have organized a combustion class for its members. This is arranged in co-operation with the Hays Institute of Combustion and classes are conducted by Hays graduates who are members of the Association as well as by the staff of the Institute.

Extension Division, University of California, Berkeley, Calif, announces a new correspondence course on Diesel engines, consisting of 15 assignments or lessons, with a fee of $7.00 ($10 for non-residents of California). No textbook is required and suggested reference books may be purchased or rented. This course is planned with a three-fold purpose: First, to adapt the course to the needs of operators who desire to learn the fundamental details of this type of equipment; second, to give a basic understanding of Diesel engines to meet the needs of a person interested in becoming an operator or salesman, but with no interest in the highly technical study of thermodynamic principles involved; third, to meet the needs of those with technical knowledge, but lacking details of operation of engines and auxiliaries.

One of the READING-PRATT & CADY Gate Valves on the main steam header in one of the plants referred to.

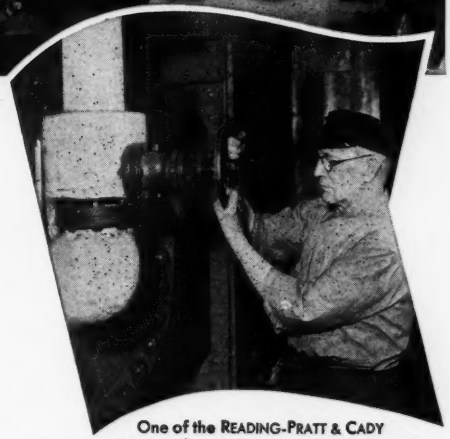
ENGINEERS SIMPLIFY THE VALVE PROBLEM FOR OPERATING AND MAINTENANCE MEN

● Complete installations were required for each of three plants—water softeners, steam plants, condensers, air conditioners, high pressure fire protection systems, and so forth.

The engineers asked for and accepted recommendations from READING-PRATT & CADY for all important valves required.

The performance of these valves justifies the confidence of the engineers and suggests that you might find helpful to you, too, READING-PRATT & CADY's close contact with the problems of modern power plants.

READING CAST STEEL VALVES AND FITTINGS
PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES



One of the READING-PRATT & CADY valves on the condenser system in the second of the group of plants referred to.

A READING-PRATT & CADY valve on the Automatic High Pressure Fire Protection system in the third of the group referred to.

READING-PRATT & CADY
READING, PENNSYLVANIA

A Division of AMERICAN CHAIN & CABLE COMPANY, INC.

IS WATER YOUR ENEMY OR ALLY?

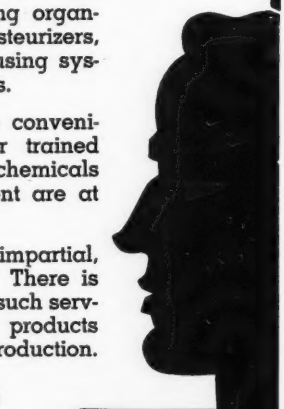
Scale, corrosion and living organisms can sabotage your plant, cause expensive shut downs, reduce production, create need for difficult replacements and consume many man-hours badly needed in production.

We know this enemy and we read his character. By proper treatment we convert this deadly enemy to a staunch ally faithfully giving you maximum efficiency and eliminating outage.

The Haering Glucoside Derivatives eliminate scale, corrosion and living organisms in boilers, condensers, pasteurizers, process equipment and water using systems and equipment of all kinds.

Water is our profession. Three conveniently located laboratories, our trained technical staff, our research, our chemicals and our proportioning equipment are at your service.

Write, wire or phone us for an impartial, fact finding survey and report. There is no charge and no obligation for such service. Our experience and our products are doing their part for all out production.



D. W. HAERING & CO., Inc.

Water and Brine Consultants

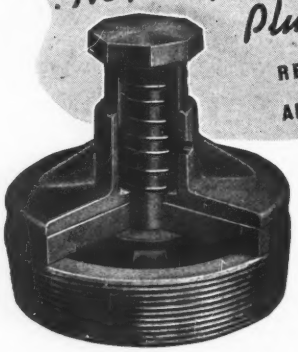
General Offices

1800 Engineering Bldg., 205 North Wacker Drive

Chicago

"No Pump Valve Repairs in 3 Years Plus a Good Coal Saving"

REPORTS ENGINEER HUGO BECK AFTER USING COMBINATION VALVES



For *Boiler Feed, Vacuum, Condenser, General Service Pumps*

WHEN fitted with old-style valves, two vacuum pumps at the Eisendrath Glove Co., Chicago, had to be taken apart at least four times during each heating season. Besides the expense of overhauling, they were inefficient—had to click off 80 strokes a minute to maintain a 7½ in. vacuum.

After facing the seats of these two pumps and fitting them with 24 non-tilting COMBINATION Pump Valves, the engineer, Hugo Beck, said: "Keeping a 26 in. vacuum now is easy as pie. And the continuous straight-lift action of these valves is helping us save quite a little coal a day."

What COMBINATION Pump Valves are saving for hundreds of other plants they can save for you. They close quickly, reduce wear, prevent slippage, make steam do more work. Seat, stud and spring are made of long-lasting Phosphor Bronze. Widely used for Boiler Feed, Vacuum, Condensate and General Use Pumps. They match the satisfaction delivered by COMBINATION Silent Check Valves.

Coupon Brings Descriptive Bulletin and Details of FREE Trial Offer.

COMBINATION PUMP VALVE CO.

846 Wiota Street **Philadelphia, Pa.**

Without obligation, please send me full details about your Trial offer on COMBINATION Pump Valves.

Name .....

Company .....

Address .....

MAIL COUPON TODAY

Acme Engineering Service, Inc., of Fort Wayne, Indiana, has filed with the Federal Power Commission an application for major license for a proposed project consisting of three dams and power houses, all on the Salamonie River, in Wabash and Huntington Counties, Indiana. The first dam is of reinforced concrete approximately ½ mile above the mouth of the River, for 8600 hp. operating under a head of 62 ft. and a Diesel engine having a capacity of 4000 hp.; the second dam is earth-filled, 6.7 miles upstream from No. 1, with installed capacity of 4300 hp. under a head of 31 ft.; the third dam is earth filled, 6.3 miles upstream from No. 2 with installed capacity of 4300 hp. under a head of 31 ft. Energy from the three plants will be transmitted to a substation at Plant No. 1, to be sold wholesale to consumers.

General announcement has been made of the 7th International Heating and Ventilating Exposition, to be held January 26-30, 1942, in the Commercial Museum at Philadelphia, Pa., under the auspices of the American Society of Heating and Ventilating Engineers. Co-incident with those dates the Society will hold its 47th annual meeting.

To extend research for new products in metallurgy, ceramics, physics, chemistry, fuels and materials treatments, Battelle Memorial Institute, Columbus, Ohio, is building a $35,000 extension to its laboratories, looking to fill present defense needs, also to reduction of production costs and expansion of industries in the future. The eighteen new laboratories and offices will care for 40 additional research engineers.

With total membership of 1703 American Society of Refrigerating Engineers shows a gain of 54 per cent in the last year and a half. New sections are now being organized in Cleveland and Kansas City. Officers of the Cleveland Section are W. W. Farr of the Refrigeration Maintenance Corp., chairman; H. D. Andress, Vilter Manufacturing Co., vice chairman; W. R. Beach, Cleveland Electric Illuminating Co., secretary; J. E. Wilhelm, Avery Engineering Co., treasurer.

In Kansas City, M. W. Pehl, Kansas City School of Engineering, is chairman and the secretary is E. L. Tramposh, Refrigeration Equipment Co.

Wisconsin Michigan Power Co., Appleton, Wisconsin, has filed with the Federal Power Commission application for a major license for its project on the Michigamme River in Michigan, including hydroelectric power generating and transmission facilities in the development.

The project or proposal covers a constructed headwater dam 50 ft. high and storage reservoir of 113,800 acre-ft., and proposed dam, reservoir, and power house about 12 miles down stream with multiple-arch concrete dam 75 ft. high, reservoir capacity of about 20,000 acre-ft., power house located about 800 ft. below the dam having installed capacity of 21,400 hp. A transmission line extending eastward about 8 miles to Randville, Michigan, and another extending, southward about 3 miles to the applicant's Brule hydroelectric plant are included.

How to Boost Wiring Capacity Without Rewiring

IMPROVE POWER-FACTOR WITH G-E PYRANOL CAPACITORS

Easy to install in out-of-the-way locations. Space-saving overhead racks could be used because Pyranol (the treating liquid in these capacitors) is noninflammable.

"With a total expenditure of less than $13,000, our savings have averaged $1,000 monthly, which is better than expected. In addition, we have had no maintenance expense." This is the profitable experience of the Murray Corporation of America, Detroit, after increasing the capacity of the plant distribution system with 1440 kva of G-E Pyranol capacitors.

You get—

1. **A 10- to 40-per cent increase in circuit capacity (depending on plant power-factor)**
2. **Savings up to 50 per cent over other mtehods**
3. **Possible savings in power cost that may pay for the capacitors in one to three years**

Does your plant use induction motors? Induction furnaces? Then the chances are that the power-factor is low—that your circuits are "clogged up" with a lot of reactive (nonworking) current. And that means that you can greatly increase the capacity of your existing wiring simply by installing G-E Pyranol capacitors on the lines. They neutralize reactive current and so permit the entire system to carry more *useful* current for additional motors and other equipment.

Equally important—if your power contract contains a power-factor-penalty or kva-demand clause, you will realize direct savings in reduced power cost that may *pay for the capacitors in from one to three years.* And the savings continue as a highly profitable return on the investment.

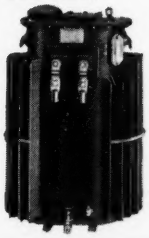
Ask your G-E representative for a quick estimate of the increase in capacity and the savings possible with Pyranol capacitors. Popular ratings are carried in stock for prompt delivery. We ship directly from the warehouse shelf.

Write for Bulletin GEA-77. General Electric, Schenectady, N. Y.

OTHER AIDS FOR OVER-LOADED SYSTEMS

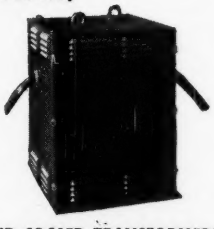
AIR-COOLED INDUCTION REGULATORS

Over-loaded circuits mean low voltage and inefficient operation of motors and lamps. G-E air-cooled induction voltage regulators will bring performance back to standard. And indoor installations are easy to make—no vault is required. (Bulletin GES-2285)



PYRANOL TRANSFORMERS

An easy way to provide for new loads. Install them indoors at *load centers* to get power right where you want it. No vaults required. Close-to-the-load installations save secondary copper, give better voltage, and reduce losses. (Bulletin GEA-2048B)



AIR-COOLED TRANSFORMERS

Like Pyranol transformers, these units can be installed indoors to obtain greater capacity plus savings in both time and materials. Particularly adapted to circuits 600 volts and below. (Bulletin GEA-897H)

GENERAL ELECTRIC

402-22-5700

This Watchdog Puts STEAM-WASTERS on the Spot

Always on the job, always accurate, Simplex Venturi Type Meters keep you constantly posted on the steam requirements of all plant equipment. They serve as a money-saving combined watch-dog and bookkeeper.

Compact in design and built for wide range service, these Simplex Meters are widely used for Boiler Feed, Steam Condensate or Evaporate flow measurement.

SIMPLEX TYPE MS METER

Furnished in any size and for operating pressures up to 2500 lb.

Write for Bulletin No. 52.

SIMPLEX VALVE & METER CO., 6790 Upland St., Philadelphia, Pa.

SIMPLEX METERS

Cave Men Read Advertising

Cave men didn't know much about boiler feed pumps, bleeder turbines or high pressure piping, but they did have to eat. Those who could observe and follow the tracks of the game they hunted or read the meaning of a broken twig were the best off in life.

Although advertising has been greatly developed in the last few thousands of years, it still brings the same substantial rewards.

The consistent reader of advertisements in POWER PLANT ENGINEERING, for example, is invariably the best informed on what power equipment to use and where to get it. Consequently he is able to render more valuable service and get more out of life.

Stoker Manufacturers Meet

LEADING STOKER manufacturers, from all parts of the United States, met recently at White Sulphur Springs, W. Va., for the twenty-fourth annual meeting of the Stoker Manufacturers Association, and, pledged full support to the nation's defense and emergency program so as to meet the demand from industry and government in both defense and non-defense projects.

Frank Hoke, Indianapolis, vice-president of Holcomb & Hoke Mfg. Co., was re-elected president. Also re-elected were: B. O. Fink, president of Auburn Foundry, Inc., Auburn, Ind., as vice president; J. M. McClintock, manager of the Stoker Div., Illinois Iron & Bolt Co., Chicago, Ill., as treasurer; and Marc G. Bluth, Chicago, as secretary.

A. S. T. M. Officers

OFFICERS ELECTED for the year of 1941-42, and announced June 24 at the first session of the 1941 Annual Convention held in Chicago, are: President, G. E. F. Lundell, Chief, Chemistry Div., National Bureau of Standards, Washington, D. C.; and Vice-president, Dean Harvey, materials engineer, Eng. Lab. and Standards Dept., Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

New members of the Executive Committee: Arthur W. Carpenter, manager, Testing Laboratories, The B. F. Goodrich Co., Akron, Ohio; T. A. Fitch, director, Bureau of Standards, City of Los Angeles, Calif.; Carl D. Hocker, Plant products engineer, Bell Telephone Laboratories, New York City; J. L. Miner, director and vice-president, Atlas Lumnite Cement Co., New York City; E. W. Upham, chief metallurgist, Engineering Dept., Chrysler Corp., Detroit, Mich.

Chicago Section A. S. M. E.

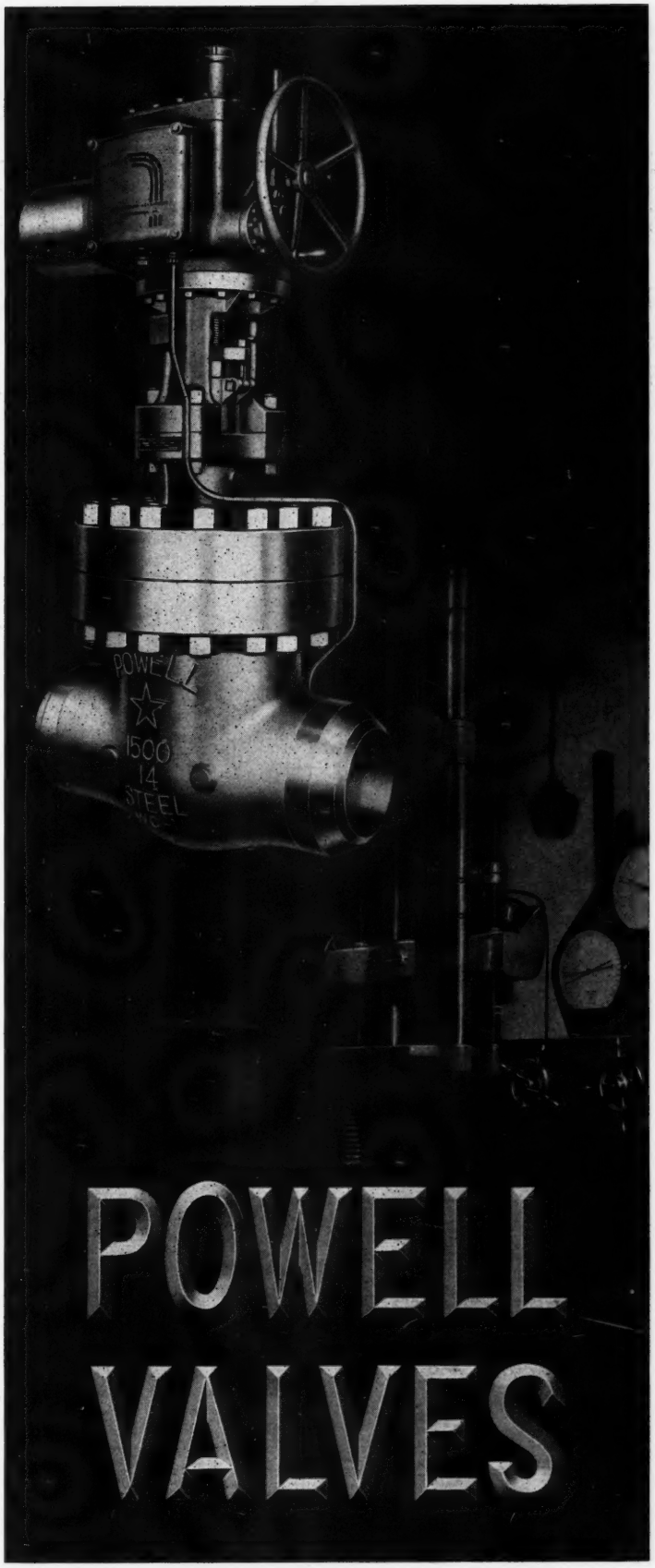
AT A MEETING of the Chicago Section of the A.S.M.E., C. C. Austin, general manager of the Mancha Storage Battery Locomotive Div., Goodman Mfg. Co., was elected Chairman for the ensuing year. The Vice-Chairmen elected are: H. M. Black; J. R. Michel; and P. A. Stephenson. Fred B. Orr was re-elected Secretary-Treasurer of the Section.

The meeting was addressed by the president of the Society, William A. Hanley, of Eli Lilly & Company, Indianapolis, Ind., who chose as his subject "Operations of The American Society of Mechanical Engineers."

One of the distinctive features of the meeting was the presentation to Joseph Weller Hays, president of the Hays School of Combustion of a token of distinction in the form of a scroll commemorating his achievements and public service as a combustion engineer. A certificate was also presented to Louis M. Ellison, president of the Ellison Draft Gage Co., in appreciation of his services as chairman of the Chicago Section for the past 2 yr.

BACKGROUND of LABORATORY CONTROL

The Valve shown here is a 14" Class, 1500 lb. Cast Steel Gate Valve for operation on 920° F. steam at approximately 1500 lb. working pressure. It is powered with Limitorque top-mounted, spring compensated, motor operator. It is but one of the many special valves which Powell engineering has created to meet the special problems which have arisen in the endless procession of industrial progress.



Behind each Powell Valve is a background of patient, tireless research. In the Powell Laboratories there is an array of scientific testing equipment which completely eliminates the possibility of uncertainty in the design, material or construction of Powell Valves.

Every successive forward step in American industry has further emphasized the ever growing importance of valves. And as these industrial advances have occurred Powell has held its place in the front rank of the scientific forces whose job it has been to work out the processes of production.

The result of this procedure over a period of years is a special made-to-order Powell Valve for every major industrial function of today—plus a scientific staff ready and eager to attack new problems as they appear in the forward march of American industry.

The Wm. Powell Company
Cincinnati, Ohio

Ask for this Bulletin

It Tells about

THERM-O-TILE

Which Is the Simplest, Strongest, Most Efficient and Only Truly Complete Conduit for Underground Pipe Lines

Monolithic concrete base. No broken stone fill. Build to correct grade and that grade will never change. Condensate pockets cannot form. Strong arched construction. No bell joints. Internal channel drain. Etc. For other reasons why Thermo-O-Tile is the superior conduit system, ask for Bulletin 381, shown above.

Thermo-O-Tile is sold and installed by Johns-Manville Construction Units in all Principal Cities.

See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.

829-E Frelinghuysen Ave., Newark, N. J.

Without obligating us in any way, ☐ Please send Bulletin 381. ☐Send a representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Name .....

Firm .....

Street .....

City ..... State.....

Philadelphia's Southwark Station

WHAT IS SAID to be the largest single order for industrial boilers, $3,000,000, was placed on May 27 by the Philadelphia Electric Co. with Babcock & Wilcox. The boilers will be installed in Philadelphia's new Southwark Generating Station. Orders for two 150,000-kw., cross compound turbo-generators were placed with Westinghouse early in April. Two of the boilers and one generating unit are scheduled for operation in the fall of 1943.

Each of the 925 lb. boilers will have a capacity of approximately 1,000,000 lb. per hr. Turbine throttle conditions will be 825 lb., 900 deg. F., the 150,000-kw. cross compound units each being made up of one 65,000-kw., 3600 r.p.m. high pressure and one 85,000-kw., 1800 r.p.m. low pressure section.

Southwark Station was announced by President Liversidge in October, 1939, after the purchase of a 9 a. site, at Delaware Ave. and Porter St., from the Pennsylvania Salt Mfg. Co. At the time it was said to be the largest Philadelphia real estate transaction in 10 yr. The initial development, estimated at $32,000,000, is so planned that the capacity can be doubled when required to give an ultimate capacity of at least 600,000-kw.

Denison Dam

U. S. ENGINEER OFFICE, Denison, Tex., has secured an additional allotment of $8,100,000 for the Denison dam and hydroelectric power project. This a total fund of $21,588,321 appropriated for the development up to the present time. The total estimated cost is placed at $48,532,321 for the dam, reservoir and hydroelectric power station. In addition, it is proposed to provide two more turbine-generators, each of 33,000-kw. capacity, for the power station, which will increase the cost given, by an estimated $3,350,000.

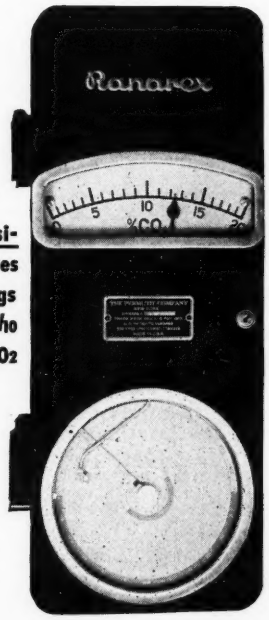
Kentucky Power

CHIEF OF ENGINEERS, United States Army, Washington, D. C., has issued orders to proceed at once on construction of the new Wolf Creek power dam and hydroelectric power project on the Cumberland River, near Jamestown (Russell County), Ky. The cost is estimated as $55,000,000. Initial appropriations have been made available and awards are scheduled to be made at once for construction of roads to the dam site and for construction of the main dam. This will be over 5280 ft. long, located about 4 mi. downstream from Rowena, Ky. The power plant will have an initial capacity of about 250,000-kw. Work will be carried out under the direction of the United States District Engineer Office, Nashville, Tenn., Major O. E. Walsh, District Engineer, and all contracts will be placed from that office.

Coffin Award to W. P. S.

WISCONSIN PUBLIC SERVICE CORP. has received the Charles A. Coffin medal for 1940, awarded by the General Electric Co. for outstanding record of performance. It was presented at the ninth annual meeting of the E. E. I. by J. E. Davidson, president of the Nebraska Power Co. and a member of the prize awards committee.

RANAREX*



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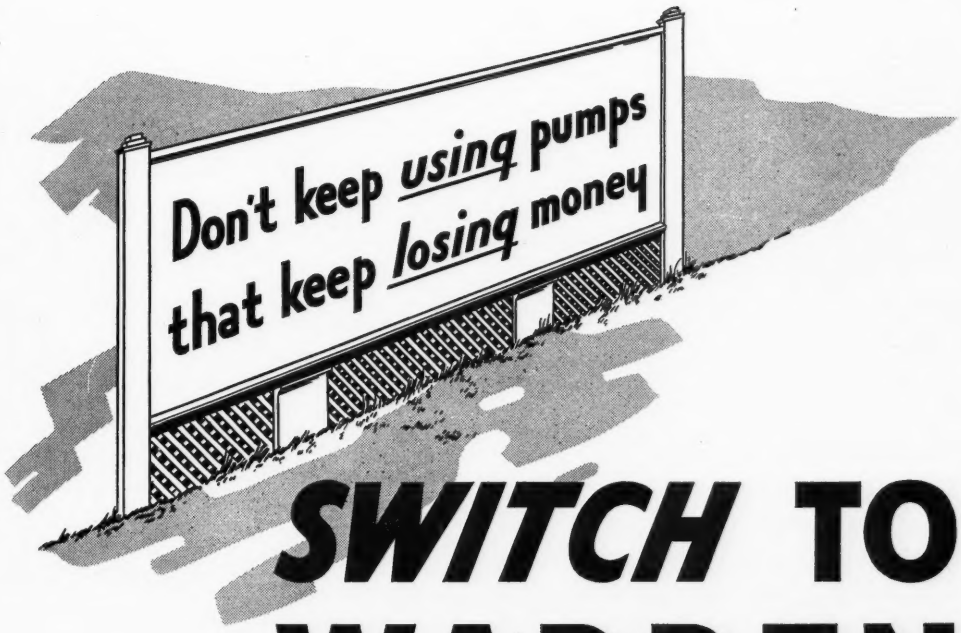

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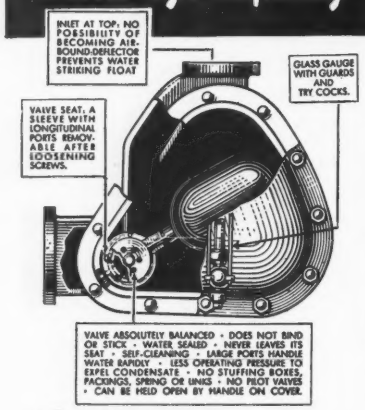
There is no place for inefficiency or waste in today's set-up. RELIABILITY is more important now than ever before. Warren Pumps are designed from start to finish for trouble-free, economical performance and are built to fit the job. They have liberal clearances that insure highest practical efficiencies and low power costs, year in and year out . . . extra heavy shafts that minimize internal wear. They have oversize bearings . . . broad-faced case rings . . . properly proportioned liquid passages. These and other important features have real significance and mean economical, uninterrupted service in your plant. Switch to Warren and save.

WARREN PUMPS

Warren Steam Pump Co., Inc., Warren, Mass.

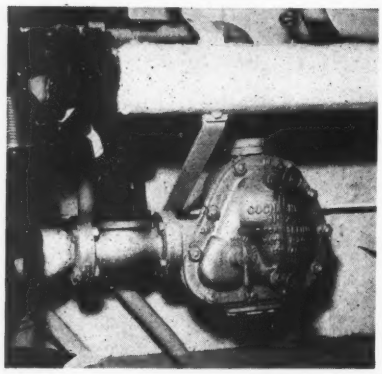
Extraordinary Discharge Capacity


INLET AT TOP: NO POSSIBILITY OF BECOMING AIR-BOUND-DEFLECTOR PREVENTS WATER STRIKING FLOAT
GLASS GAUGE WITH GUARDS AND TRY COCKS.
VALVE SEAT, A SLEEVE WITH LONGITUDINAL PORTS REMOVABLE AFTER LOOSENING SCREWS.
VALVE ABSOLUTELY BALANCED • DOES NOT BIND OR STICK • WATER SEALED • NEVER LEAVES ITS SEAT • SELF-CLEANING • LARGE PORTS HANDLE WATER RAPIDLY • LESS OPERATING PRESSURE TO EXPEL CONDENSATE • NO STUFFING BOXES, PACKINGS, SPRING OR LINKS • NO PILOT VALVES • CAN BE HELD OPEN BY HANDLE ON COVER.

Cochrane

MULTIPORT DRAINER

for *Quick* Drainage of *Large Quantities* of Condensate . . .



THE "Multiport" principle on which the Cochrane Drainer operates is that of a hollow cylindrical valve with a number of longitudinal ports which register with similar ports in the valve seat when the float is in the raised position. The combined capacities of these ports is unusually large, which accounts for the valve's extraordinary discharge capacity. For complete details mail this coupon.

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Considerations in determining the award to the Wisconsin corporation were: Increased residential and farm sales; increased electric revenue spite of rate reductions; increased appliance sales; reduced interest charges due to refinancing, notwithstanding an increase in interest-bearing securities; program of cost analyses and comparison of practices whereby electric operating expenses were reduced 8½ per cent against a general national increase in such expenses; adoption of a guaranteed annual wage plan; development of a plan of reservoir operation which, without added investment, increased firm hydro power almost 40 per cent; and the rebuilding of the Grandfather Falls hydro plant at a construction cost comparable to that of steam stations.

The guaranteed wage plan for employees of the Corporation provides a full year's employment and wages while the company obtains the benefit of averaging time, thus avoiding difficulties of a fluctuating payroll.

G. L. Power Club Officers

AT THE LAST MEETING of the Great Lakes Power Club in Chicago, June 6, officers for the ensuing year were unanimously elected and later inducted into office. They include: President, J. D. Howard, Wisconsin Power & Light Co., Madison, Wis.; Vice president, W. M. Woll, Commonwealth Edison Co., Chicago; Secretary-treasurer, R. P. McClellan, Consumers Power Co., Grand Rapids, Mich.; and, to the Board of Directors for a 4 yr. term, P. W. Romig, Wisconsin Public Service Co., Green Bay, Wis. Messrs. Howard and Woll were respectively vice president and secretary-treasurer during the past year.

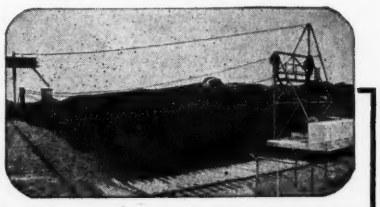
The retiring president, W. V. Woodward, Northern Indiana P. S. Co., Hammond, Ind., automatically became a member of the Board of Directors. The other three directors are: J. B. Bailey, Indianapolis Power & Light Co., Indianapolis; A. M. Young, Central Illinois P. S. Co., Springfield, Ill.; and C. H. Purdy, Consumers Power Co., Jackson, Mich. At the Board Meeting Mr. Bailey was elected chairman.

A. I. E. E. Officers

DAVID C. PRINCE, manager, Commercial Eng. Dept., General Electric Co., Schenectady, N. Y., was elected president of the A.I.E.E. for the year beginning August 1, 1941. The other officers elected were: Vice-Presidents, N. S. Hibshman, Bethlehem, Pa.; J. Elmer Houseley, Alcoa, Tenn.; Arthur L. Jones, Denver, Colo.; Walter C. Smith, San Francisco, Cal.; C. A. Price, Hamilton, Ont. Directors: Lester R. Gamble, Spokane, Wash.; T. G. LeClair, Chicago, Ill.; Fred R. Maxwell, Jr., Pensacola, Fla. National treasurer, W. I. Slichter, New York, N. Y. (Reelected). These officers together with the hold-over officers will constitute the Board of Directors for the next administrative year. The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30, 1941, of 17,886. In addition to three national conventions and two District meetings, 1866 meetings were held during the year by the local organizations of the Institute in the principal cities and educational institutions in the United States, Canada, and Mexico.

SAUERMAN

Power Scrapers



STORING COAL

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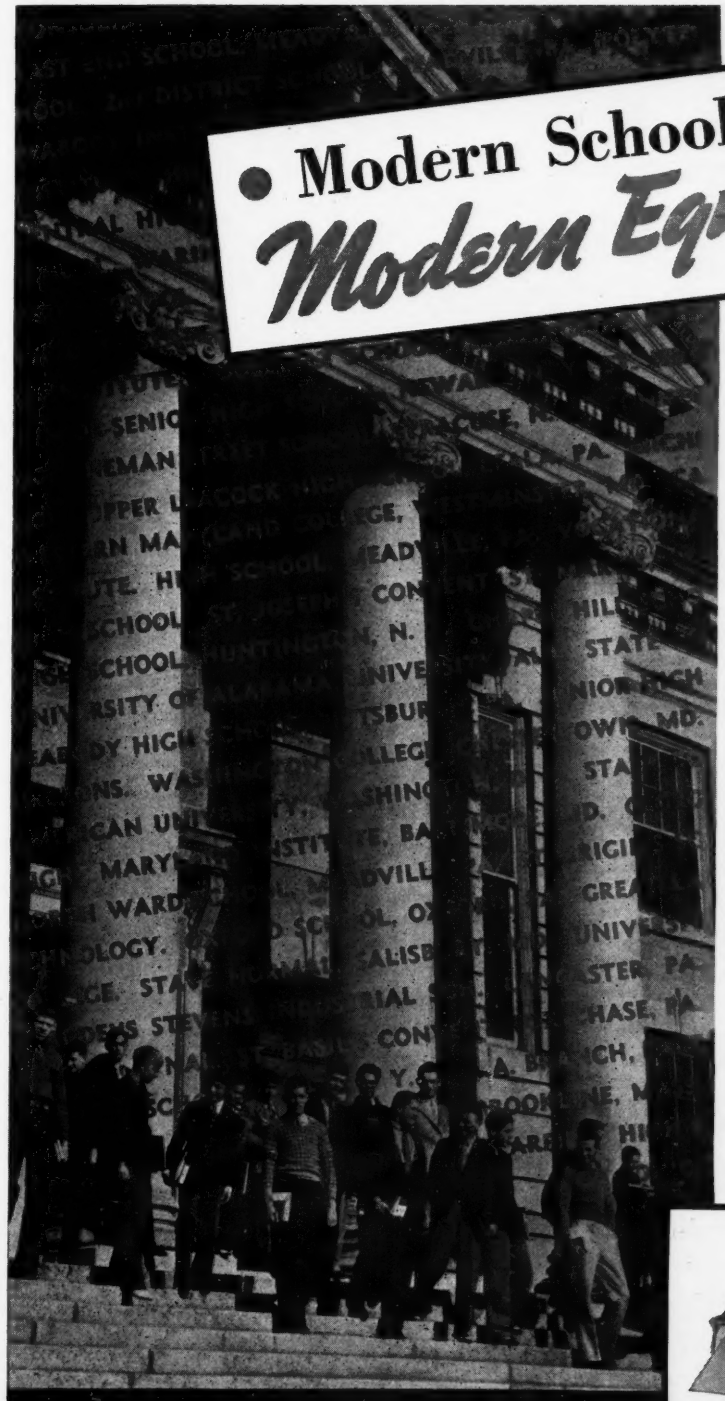
Wanted: Experienced operators on large high pressure turbines, auxiliaries, powdered fuel boilers. Location approximately 100 miles from Philadelphia, Pa. Box 1211 Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

Graduate Mechanical Engineers, preferably under 40, with practical experience in boiler-room operation and knowledge of combustion problems. No applications considered unless accompanied with complete history of applicant's background and experience. Box 1212 Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

Mechanical Engineering graduates not over 40 for design and assembly layout of boilers and accessory equipment. Knowledge of descriptive geometry and thermodynamic calculations very helpful. Location, Middle West and East. Applications must include full resume of schooling, firms worked for and details of experience. Box 1213 Power Plant Engineering, 53 W. Jackson Blvd., Chicago, Ill.

Free Watch Charm Offered

Jenkins Bros. is making an interesting free offer to readers of Power Plant Engineering. If you will send your name and address on a penny post card to Dept. BJ, 80 White St., New York, N. Y., you will receive a handsome valve charm for your watch chain.



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Stokers

A school, whether endowed or supported by taxpayers, must be a model of efficiency throughout the entire school plant. That's why so many of America's great schools have boilers equipped with "F & E" Stokers—the stokers that assure efficiency where operations really begin—in the boiler room. Under the broad heading of efficiency come economy, dependability, low maintenance and upkeep—the combination of proved advantages that have made "F & E" Stokers the choice of those who demand and expect equipment to give the most in performance at lowest possible cost.

There is an "F & E" Stoker designed for practically every heating or power need for schools and colleges. Every "F & E" Stoker incorporates the patented Interval Timer Governor for perfect coal-feed control and the Straight Line Drive for simplicity and for positive power transmission. Many other features, including the Fuel Bed Regulator and the Sliding Bottom Retort combine to make "F & E" the stoker that offers the utmost in stoker engineering. To these features is added the experience of more than 25 years of manufacturing and installing stokers in every field where heat or power is required.

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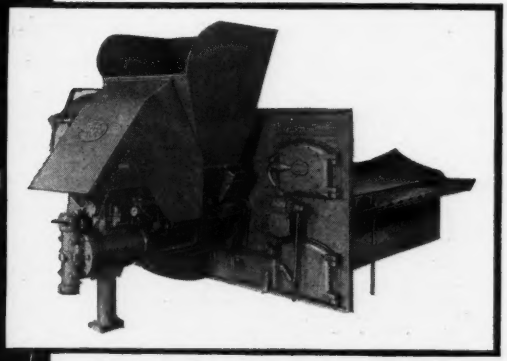

The Series 60 "F & E" Underfeed Stoker. Designed for boilers requiring output ranging from 5,000 to 15,000 lbs. of steam per hour. Electro-hydraulic or steam drive optional. Air supply and coal feed completely synchronized to give perfect combustion.

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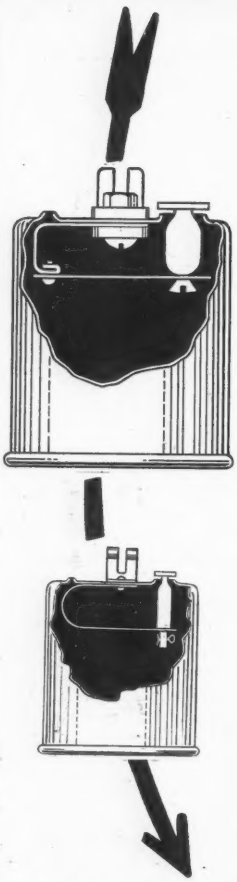

An ingenious device that makes the K-Master Steam Trap ideal where

LARGE VOLUMES OF AIR OR GAS

must be vented quickly from a cold line or piece of apparatus

You've heard of the K-Master Self-Cleaning vent now standard on all K-Master Steam Traps which sees to it that the normal vent in the bucket is kept free from clogging. Many have bought the K-Master Trap just because of this.

Above is illustrated the K-Master Thermo-Float, which is optional. This device is recommended on traps bought for lines or equipment which when heating up must be rid of large volumes of air or gas. The Thermo-Float automatically opens and closes a large auxiliary vent. When the excess air is passed this vent is closed. The normal self-cleaning vent stays open.

If you have such a trap condition, try a K-Master with the Thermo-Float and note the increased efficiency in service.

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New Engineering Books

Machine Design. By Louis J. Bradford and Paul B. Eaton. Published by John Wiley & Sons, 440 Fourth Ave., New York City. Size 6 by 9 in., 263 pp., cloth bound, fourth edition. Price $3.00.

This book, now in its fourth edition, is too well known as a text to require a detailed review although the changes made in the new edition warrant more than passing notice. These changes are concerned with, and were made necessary by: advances in gear design as approved by the A.G.M.A.; changes in spring design; increasing importance of V-belts; and, the widespread use of roller and ball bearings.

The text itself deals with design fundamentals, intended to show the application and use of data and not to act as a handbook in itself. A knowledge of kinematics and mechanics is assumed and these subjects where needed for clarity or review are touched on but briefly. Short cuts, solutions and formulas of the handbook type are not used, but the principles involved are illustrated by example and large numbers of illustrated problems follow each chapter.

These chapters, 12 in number, cover fundamentals, friction, lubrication, bearings, clutches, brakes, shafts, force and shrink fits, screws, gearing, belts, chains, springs, flywheels and miscellaneous machine elements. The book is small, concisely but clearly written and, most important for a book of this kind, it is up-to-date with emphasis placed on machine elements and parts used in contemporary practice.

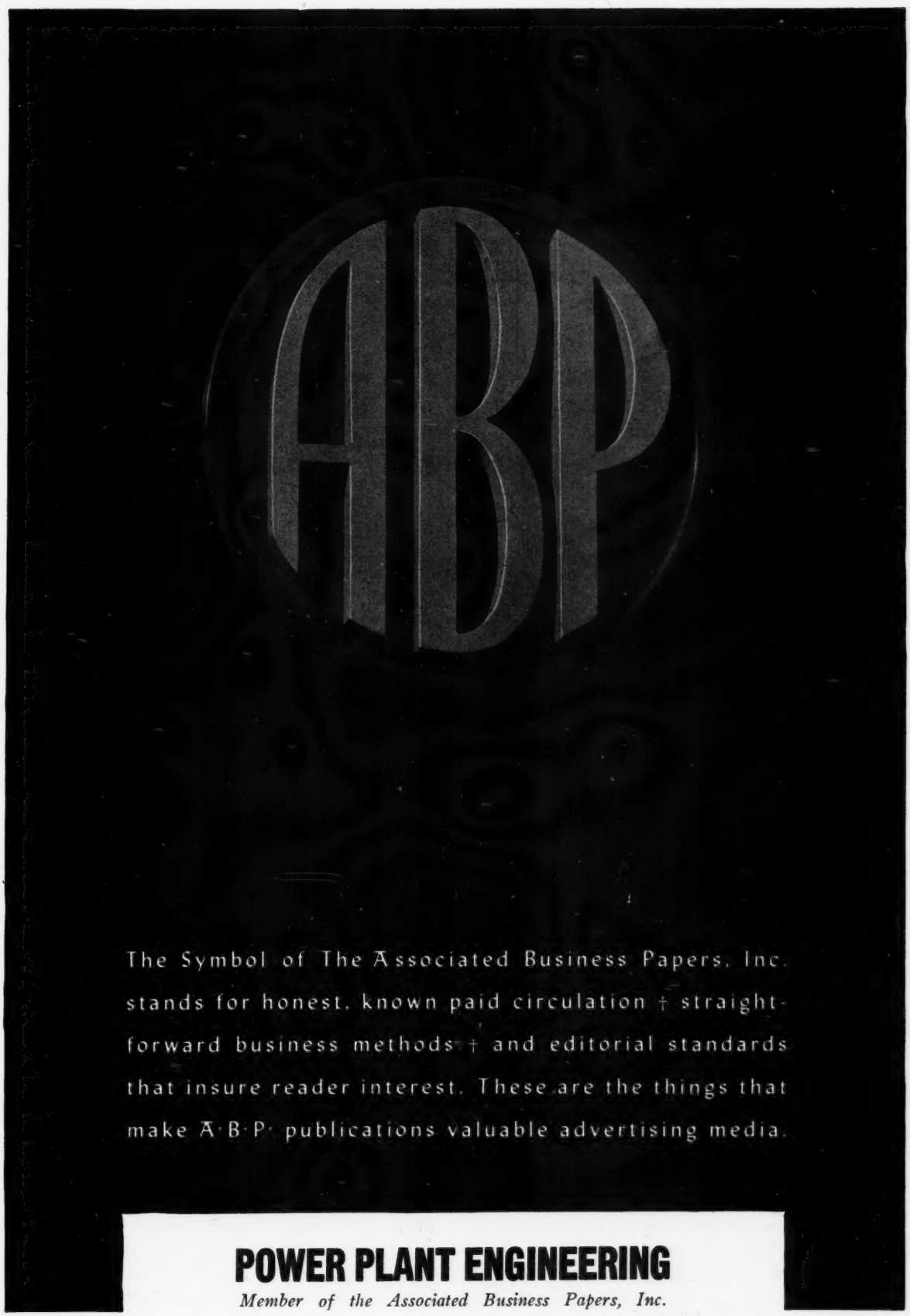
A Good Mechanic Seldom Gets Hurt. By Herman R. Graman. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5 by 7 in., 94 pp., paper cover, spiral binding. Price 50 ct.

Last year almost 50,000 man-years of lost time, 95 per cent preventable, was caused by partial disability accidents, and due to the large number of new defense workers this is expected to be much larger next year. Therefore this informal talk by Safety Joe is timely and the twins, Accident Moe and Careless Bow, help to get the story across. It deals very briefly (11 lines) with first aid, but at length on: the safe operation of dozens of specific machine tools; grinders; hand tools; soldering; welding; bench work; tool cribs; forges; furnaces, etc.; finally, in 3 pp. "How to become a good machinist"; and, 6 pp. of quiz questions. The author is Assistant Supervisor of Defense Training, Parker Vocational High School, Dayton, O.

Machine Trades Blueprint Reading. By Russel W. Ihne and Walter E. Streeter. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 8½ by 11 in., 138 pp.; (plus blueprints and graph paper) paper cover, spiral binding. Price $2.00.

No time wasted on theory here—it's all in practical "How-to-do-it" style based on actual blueprints taken from industry. There are plenty of questions and answers too so that you can keep on the right track. All the basic information necessary to interpret a print is included, covering the alphabet of lines, the methods of projection, relationship of views, and an explanation of dimensioning. This is presented largely as an integral part of a variety of problems. The glossary of shop terms presented in the beginning gives essential information on terms which appear on drawings. An understanding of these terms is essential to a proper understanding of the drawings.

Problems in shop arithmetic have been introduced as a review of numbers, fractions and decimals and their application to the checking of dimensions. Machine Trades Blueprint Reading is a book ideally adapted for class use in vocational, trade and evening schools as well as in National Defense Training Classes. The authors are respectively; Assistant State Supervisor of Industrial Education in Indiana; and Industrial Engineer, Aluminum Co. of America.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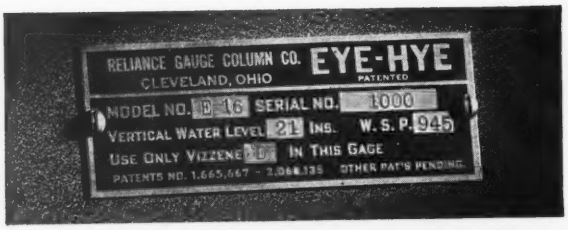
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New Remote-Reading Reliance Water Gage Adds Safety to Boilers Everywhere. Prominent Mid-West Utility Gets EYE-HYE No. 1000

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Write today for EYE-HYE Bulletin 382, and Bulletin 416—the "Blue Book" list of EYE-HYE users.

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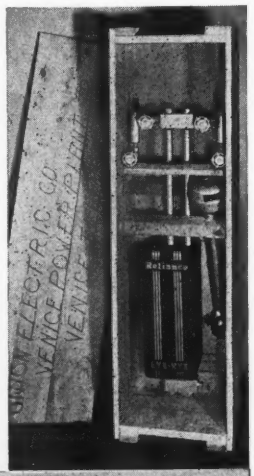

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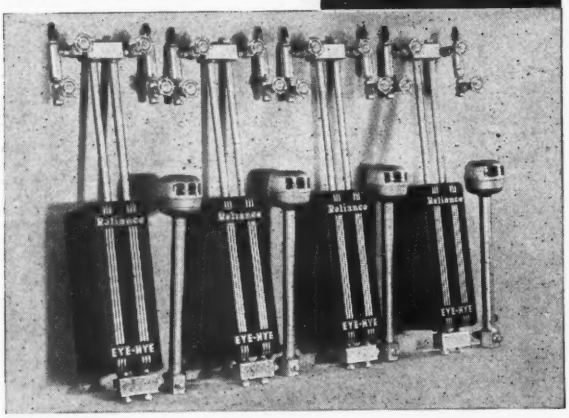


BOILER SAFETY DEVICES since 1884

Reliance

Fifty Hints for Teachers of Vocational Subjects. By M. R. Bass. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8¼ in., 46 pp., planographed, paper cover, spiral binding. Price 50 ct.

At this time when vocational school and defense training courses are being expanded at a tremendous rate, this is an extremely important book. Thousands of new instructors will find it contains a world of practical information on conducting classes, arranging class work, tests, classroom habits, encouraging students to think, fixing homework, effective presentation, etc. It is not a text book but a short informal discussion, of problems with which every instructor is faced, by an author who knows whereof he speaks. He was formerly associate director of the William Hood Dunwoodie Industrial Institute of Memphis and is now director of the David Rankin School of mechanical trades, St. Louis.

The Hydraulic Ram. By Wallace M. Lansford and Warren G. Dugan. Published as Bulletin No. 326 by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Size 6 by 9 in., 68 pp., paper bound. Price 70 ct. (Limited number available for free distribution.)

This is an analytical and experimental study of the hydraulic ram, a machine which uses the kinetic energy of a moving column of water to lift part of the water to a greater height than the source of supply. Experimental data was obtained from work with two different size Rife Rams. They differed considerably from those used by O'Brien and Gosline (Univ. of Cal., Pub. in Eng., Vol. 3 No. 1, 1933) in that there was a decided effect from the elasticity of the resilient waste valve disc. Conclusions reached are that the delivery, and waste, per cycle can be predicted within 10 per cent; both quantities are decreased by increasing the delivery head; the time of the cycle decreases with the delivery head up to a certain point and then increases; and the maximum efficiency varies little with adjustment of the waste valve.

The Pickwick Landing Project. Prepared by The Tennessee Valley Authority as Technical Report No. 3. For sale by the Superintendent of Documents, Washington, D. C. Size 5 by 8 in., 431 pp., cloth bound. Price $1.00.

This report has been prepared to give to the engineering profession and the general public facts about the planning, design and construction of Pickwick Landing project on the Tennessee River. It covers: the general program of the unified development; the part played by the Pickwick Landing project; preliminary project investigations; lock, dam, and powerhouse designs; employee housing; construction methods; reservoir adjustments; initial operations; and a complete summary of construction costs. Appendices include a statistical summary; consultants' reports; and special tests and model studies. It is the third of a series of TVA Technical Reports, the first of which is The Norris Project report, published in 1939, and the second, The Wheeler Project report, published in 1940.

Bond Between Concrete and Steel is a detailed report of an extensive experimental investigation made to determine the bond between the two materials. This is essential if the increased strength and uniformity of modern steel and concrete is made effective by the use of higher design stresses. It is a 110 p., 6 by 9 in., paper bound book published as Bulletin 147 (and distributed free of charge) by the Iowa Engineering Experiment Station, Iowa State College, Ames, Ia. The authors are Herbert J. Gilkey, Stephen J. Chamberlain and Robert W. Beal, all of the college staff.

Electric Power Requirements and Supply. This 140 pp., 8½ by 11 in. paper bound, planographed book has been recently issued. It covers the electric power requirements and supply in the United States for Class 1 Electric Utility Systems as of March 1941. It is identified as F.P.C. publication P7, is revised frequently and supplements issued. It may be obtained from the Federal Power Commission, Washington, for a yearly subscription price of $3.00 payable in advance. Included are tabulated and graphical data on the 48 power supply areas. The graphs show, electric generation, peak loads and installed capacity for each area, based on past records from 1937 to March 1941, and estimates from the present to the end of 1942.

The Manuscript, A Guide For Its Preparation. Third Edition. By the Staff of John Wiley & Sons. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Size 6 by 9 in.; 75 pp.; hard bound cloth cover. Price $1.00. Copyright 1941.

This excellent little book contains the essential information an author should have for the preparation of manuscript to be presented in book form. Although in previous editions explanations of various manufacturing processes were given, all these descriptions were omitted from this edition allowing space for more detailed suggestions regarding the actual preparation of manuscript material. The book is divided into two parts, the first of which deals with directions for the preparation of the manuscript and illustrations. In this, specific directions are given for the preparation of copy for the printer with illustrations of markings for corrections and type styles. General information is given on punctuation, the use of numbers, abbreviations, capitalization, how to handle quotations, illustrative material and other phases of preparation that are often confusing to authors. In the second part are given directions to the author for handling the various proofs that come to him for approval between the setting of the type and the binding of the book. An abridged glossary of terms used in the manufacture of books is included. The book is not a manual, for it does not confine the author to any set rules or styles, rather it gives him plenty of opportunity for initiative, but enables him to use language and directions that are familiar to the publisher, and thus to present his work in an acceptable style.

Chase Electrical Handbook. Chase Brass & Copper Co., Inc., Waterbury, Conn. 295 pp., 6 by 8¼ in., flexible simulated leather.

A small volume of tables and related data that will be found very helpful in the selection and application of electrical conductors.

How You Can Get a Better Job. By Willard K. Lasher and Edward A. Richards. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8½ in., 175 pp., cloth bound. Price $1.50.

The purpose of this book is concisely set forth in the foreword as: "For men and women who are seeking employment, or for those determined to leave the jobs they are doing, not by quitting but by earning a promotion. Promotion comes to those who increase their worth—seldom to others."

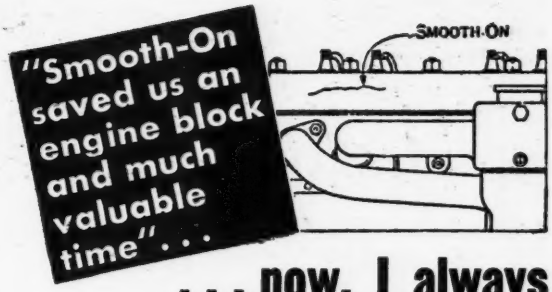
Development of this theme in a practical manner by men with years of experience on the "hiring line" makes interesting reading quite aside from its intrinsic value to those considering a change. While each individual must live within his own abilities there are fundamental principles of thinking and acting which to a large extent determine the degree of success in life. The first part of the book deals with the Human Element—the proper relation of the individual to others with whom he must deal. The second part on Self Management—is introspective, dealing with the individual's ambitions, determination and will to succeed.

The third part on Selling Yourself is perhaps most important, a practical guide to checking up on abilities, finding a job to fit them, writing letters of application, conducting, and preparation for, an interview, getting adjusted to a new job, asking for a promotion, etc.

Mr. Lasher, student counselor, is past divisional chairman of vocational guidance and placement of the Illinois-eastern Iowa district of Kiwanis International and Mr. Richards was formerly associate director of University Extension at Columbia University.

Distribution Transformer Load Supervision. Publication No. H6. Published March, 1941, by The Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Price 60 ct. to members and their employes, $1.50 to non-members in the U.S.A.

This 34 page bulletin is a report of the Overhead Distribution Group of the Transmission and Distribution Committee of the Edison Electric Institute. It is one of a series designed to provide the test and experience data necessary to encourage and enable the economical loading of distribution transformers. This report outlines various methods in use for the economical loading of transformers and presents methods for analyzing local conditions to determine criteria for maximum allowable loading.



...now, I always keep a can of Smooth-On handy

It was during a rush of war work—the water jacket of an indispensable internal combustion engine developed a crack which kept getting worse—welders would not guarantee results of welding, and it would take weeks to get a new block. So Smooth-On No. 1 was tried. It was applied on Sunday, on Monday morning the engine was back at work with no loss of time from the regular schedule, and the Smooth-On repair was so satisfactory that a year later the engine was considered worth the expense of new piston rings. No wonder this engineer, like thousands of others, always keeps a can of Smooth-On handy for emergencies.

Many other speedy, low-cost repairs

Cracks in castings of engines, heaters, pumps, valves and process apparatus, leaks at seams, bolts, rivets and joints of equipment and pipe lines, and loose parts of machinery and fixtures can be repaired with Smooth-On quickly and inexpensively without heat, special tools, or previous experience. Simple concise instructions are contained in the free Smooth-On Handbook which every engineer should have.

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Be sure to write TODAY for this useful repair manual—it will save you time, money and expense on emergency repair and routine maintenance jobs all over the plant. A postal card will bring your copy by return mail.

Buy Smooth-On No. 1 in 7-oz., 1-lb., 5-lb. cans, or 25-lb., 100-lb. kegs from your dealer or if necessary, from us.

For your protection, insist on Smooth-On, used by engineers since 1895.

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The iron repair cement of 1000 uses

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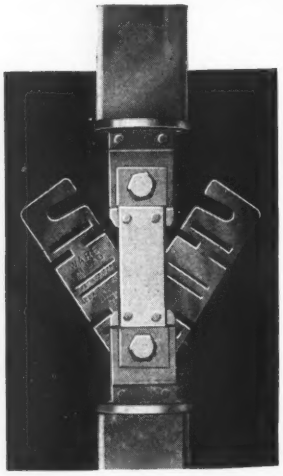
"THE day we snapped in WARE *Hi-Lag* Fuses on all our power circuits we said goodbye to the bother and expense due to needless blowouts. Buy WARE *Hi-Lags* and be fuse-happy is the slogan in our plant."

This plant engineer is right. The high time lag built into WARE *Hi-Lag* Fuses enables them to absorb momentary surges or starting loads. They soon return their cost through savings of lost production time.



Other advanced features, such as the Double-bridge, self-aligned assembly to insure extra strength—Simplified Construction that is easier to renew than overload — Spring Tension Contacts to insure greater contact surface —all make WARE *Hi-Lags* the outstanding buy in the fuse field.

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Mechanism. By Stanton E. Winston. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 5½ by 8½ in., cloth bound, 365 pp. Price $3.50.

Machines with which the engineer must work in the generation, transmission and utilization of power consist of mechanical elements put together in such a way as to accomplish the desired purpose. The branch of engineering concerned with these mechanical movements and combination of links or machine parts is known as Mechanism or Kinematics.

In this book the author has emphasized the fundamental theory of the subject, analyzed thoroughly the basic elements involved and shown by example how these simple elements are combined to give more complicated motions. A large number of representative examples are worked out in the book as practical applications of the theory and many problems are included for further practice.

The graphical method of analysis is stressed because in general algebraic solutions in this field are unduly involved. The book is written as an elementary text, complete in itself so as to require no outside reference, although a working knowledge of elementary trigonometry is assumed. The author is Associate Professor of Mechanical Engineering at Illinois Institute of Technology. The author's earlier Machine Design is a companion volume to Mechanism. Machine design is an extension of the same branch of engineering in that it deals with the proper proportioning of parts to withstand the stresses to which they will be subjected in service.

Electric Light and Power Statistics—1940. Publication I-2 (May, 1940) of the Edison Electric Institute, 420 Lexington Ave., New York City. Size 8 by 11 in., 40 pp., paper bound. Price to members 75 ct., U. S. non-members 75 ct., foreign countries 85 ct.

Covers complete plant and operating statistics of the entire electric light and power industry (both private and public) supplying power to the public; miscellaneous statistics on appliance sales, transmission and distribution lines and construction expenditures for all except the Federal hydro-electric projects; and financial statistics on private utilities only. The bulletin follows the same general form as used by the Institute in past years but with some changes and adjustment made necessary to fit this report, covering 100 per cent of the industry, with past reports, covering only private utilities, so as to give a reasonably accurate and consistent series.

Proceedings of the Midwest Power Conference, Vol. IV, 1941. Published by Illinois Institute of Technology, 3300 Federal St., Chicago, Ill. Size 6 by 9 in., 187 pp., paper bound. Price $2.00.

A collection of the 19 papers presented at the Conference, held in Chicago, April 9-10, 1941, and sponsored by I.I.T. in co-operation with seven middlewestern colleges and a number of engineering societies. These papers were presented at nine meetings covering all phases of power production, transmission and consumption, a number of the papers dealing specifically with national defense. A list of the papers with detailed comment on many of them can be found in the Conference report on p. 81 of the May issue.

MKS Units and Dimensions. By G. E. M. Jauncey and A. S. Langsdorf. Published by The MacMillan Co., 60 Fifth Ave., New York City. Size 5½ by 8½ in., 60 pp., stiff cardboard cover. Price $1.00.

Since its recommendation by the British Advancement of Science in 1868, the centimeter-gram-second (c.g.s.) system of units has been well standardized in scientific work, and in basic engineering work as well, in spite of the fact that the units are inconceivably small for most work and introduce certain inconsistencies when used in connection with electrical units.

To remedy this, the International Electrotechnical Commission in 1935 adopted the meter-kilogram-second (MKS) as basis units to become effective in January, 1940. While these three dimensions are adequate for mechanics, a fourth fundamental unit is necessary for electrical quantities. In the past several units have been used leading to more or

less confusion of thought. At the 1935 I.E.C. meeting this question was left open but the authors advocate the ohm as the fourth unit, largely because a standard of resistance similar to the meter and kilogram can be set up, copied and accurately compared. This gives the MKOS system. The development of the electrical quantities has been simplified by a number of very apt mechanical analogies.

The book, which is in fact quite an unusual little book, gives the historical background, reasons for adopting the MKOS units, and describes methods of changing from one set of units to another. It is intended primarily for electrical engineers, physicists, students and teachers. To those who have some understanding of force and mass or as the physicists say gravitational and absolute units, it will prove its worth many times over, and to electrical engineers will be invaluable.

To those engineers already struggling with engineering units it may prove confusing at first, but in the end should prove a valuable aid in bridging the gap between the two sets of units which must be done sooner or later. This, in spite of the fact that the authors refer slightingly to the engineer's pet unit of mass as "slugs . . . in effect a new and unwarranted unit of mass." The unit of force, the Newton in the MKS system, compares to the dyne of the c.g.s. system and the poundal of the g.p.s. system.

The authors are respectively Professor of Physics and Dean of the School of Engineering, Washington University, St. Louis.

Abbreviations for Scientific and Engineering Terms. Published by the American Standards Association, 29 W. 39th St., New York City, as American Standard D10.1-1941. Size 8½ by 10½ in.; 7 pp., paper covered. Price 35 ct.

This is the latest revision of a list prepared by a committee and subsequently approved by five sponsor organizations, the A.A.A.S., A.I.E.E., A.S.C.E., S.P.E.E. and A.S.M.E. In general the committee has made the following distinction between symbols and abbreviations: Letter symbols are letters used to represent magnitudes of physical quantities in equations and mathematical formulas. Abbreviations are shortened forms of names or expressions employed in texts and tabulations and should not be used in equations. The abbreviations included in this publication are the forms preferred in typewritten or printed text, and the list includes some 250 terms. On the back of the booklet is a list of other abbreviations, symbols and charts for specific industries or branches of engineering, ranging in price from 20 ct. up to $1.25.

Turbines and Condensers—1940. Published as Publication No. H9 of the Edison Electric Institute, 420 Lexington Ave., New York City. Size 8½ by 11 in., 47 pp., paper bound. Price 80 ct. to members; $2.00 to U. S. non-members; $2.10 foreign.

Issued late in April, this bulletin is the report of the Prime Movers Committee covering turbines, condensers and related equipment including heaters, evaporators, and instruments, with a section on the elimination of occluded gases from the cycle. It is in seven general sections, each containing a general analysis by the subcommittee, detailed statements and experiences of operating companies and statements of manufacturers. The turbine operating and outage data covers more than 14 mil. kw. of turbine capacity. Outside of the annual inspection periods, blades and buckets was the largest single outage factor accounting for 12.56 per cent of the total outage hours. Average generation per unit increased 13.5 per cent over the previous year.

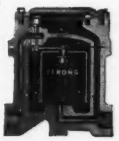
Designing Timber Connector Structures. By J. E. Myer, Research Engineer, Timber Engineering Co. Distributed by the National Lumber Mfr. Assn., 1337 Connecticut Ave., Washington, D. C. Size 8½ by 11 in., 21 pp., paper bound. Free of charge to engineers, architects and professors in engineering colleges.

This booklet is a practical discussion of the types, use and design of timber connectors, conditions affecting connector loads, factors influencing connector joint details, methods of computing sizes of structural members, discussion of joints loaded parallel to grain and at angle to grain and formulas for determining stresses in members with combined bending and axial loads. Recommended procedure for designing timber connector structures is given in detail and examples illustrating the necessary steps are included. A loose-leaf insert illustrates load variations for timber connectors with different end distances, edge distances, spacings, and angle of load to grain.

PIPEWRENCH PETE SAYS:

THIS NEWS WENT TO THE FRONT OFFICE... AND NOW THEY CALL ME MISTER!

Steam costs money. The "big shots" know it. And when their new battery of cookers uses 27% LESS, they want to know why. I'm still wonderin' why they gave me an office with my name on the door for tellin' them plain horse sense like this:



1 STRONG 70-T TRAP for quick-heating cookers, etc. Lets out all the air. Shuts tight soon as steam hits it. Can't dribble because of the exclusive anti-balancing device. Packs as much quality as Strong's larger inverted bucket (80 series) trap. Guaranteed a year.

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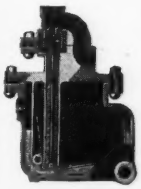

2 STRONG 30 REGULAR TRAP for any drainage job, particularly separators, headers, engine manifolds. Install one and watch it work. You'll still be patting yourself on the back 10, 15 years from now, on account of the Anumetl valves and seats and wear-proof parts.

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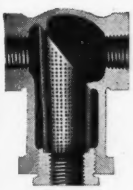

3 STRONG, QUICK-CLEANING STRAINER. Makes reducing valves, traps, controls, etc., live longer and work better, by taking out scale, dirt, grit or sand. Just open the blow-off to clean it.

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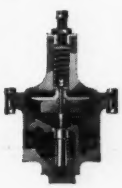

4 STRONG REDUCING VALVES. Type K of complete line shown. Name your own reduced pressure from 85 pounds down, and this valve keeps right on giving it to you. ANUMETL valves and seats guaranteed for a year.

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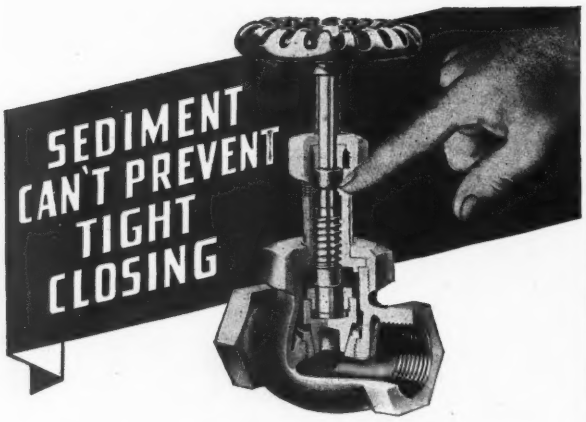

Ever have trouble repacking the stuffing box of a valve because sediment had accumulated in the bonnet chamber? That can't happen with the *top* seat in Fairbanks Plug Valves. A tight seat is always certain because the shoulder on the stem which engages the seat in the bonnet is ABOVE the threads on the stem.

This tight closing feature makes it impossible for scalding steam or hot liquids to escape and burn your hands when repacking the stuffing box under pressure.

This method of top seating also eliminates the possibility of pitting or scoring which occurs when the seating surface is in the stream line.

Another outstanding feature of these valves is the wide sealing surface in the seat and disc and the angle of the plug. This construction distributes the stream flow so it is never concentrated in one position and gives protection against galling and wire drawing. These parts can be replaced easily and quickly, or reground, without removing the body from the pipe line.

Throughout, you'll find many other instances of the unusual care used in the design and manufacture of Fairbanks Plug Valves.

You can get Fairbanks Valves in bronze and iron for practically every condition. Write for name of our nearest distributor and Catalog No. 21.

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Valves, Dart Unions, Hand Trucks and Wheelbarrows

Boston, Mass., Pittsburgh, Pa.
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Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks
***Standard and* Renewable Valves**

FOR THE ENGINEER'S LIBRARY

Coupon for obtaining free literature listed here may be found on page 145, under the heading Helpful Bulletins.

Boiler Room Equipment

1 Stoker—Catalog, No. SS-2, 12 pp. describes the latest design features of the C-E Spreader Stoker; shows photographic illustrations of assemblies; typical installations and setting drawings. This method of firing is applicable to various types of boilers, including the return-tubular boiler, sectional-header and box-header boilers, the low-head three-drum boiler, and the VU type steam generator, using a wide range of fuels. Combustion Engineering Co., Inc.

2 Boilers—Erie City Water Tube boilers, Type V-L, in sizes from 100 to 300 hp., are described and installations illustrated in a new 8 pp. catalog in color. This is a 2-drum boiler with water cooled furnaces, adaptable to any method of firing. Seven sizes up to 300 hp. can be shipped as built-up units. Larger boilers of this type are available for field erection. Erie City Iron Works.

3 Coal Scale—Features of the Seco coal scales are shown in a recent bulletin. It is made in 200 and 400-lb. sizes for automatic intermittent weighing in boiler plants or conveying systems. Stock Engineering Co.

4 Grates—Grates for burning all solid fuels are described and illustrated in detail in a recently released catalog. Hand-fired stokers, a new anthracite dumping grate and sectional boiler fronts are included. The McClave Co.

5 Feedwater Regulators—Recently issued Bulletin 433, is an 8 pp. booklet entitled Controlling Water Level on Integral Furnace Boilers. The bulletin refers specifically to the Derby Gas & Electric Co. installation at Derby, Conn., Gibbs & Hill, Inc., Consulting Engineers, which was described on page 762 of the December, 1939 issue of Power Plant Engineering. Northern Equipment Co.

6 Boiler Tubes—Clear, concise outline of information necessary in filling orders for bent replacement tubes is given on Technical Data Card No. 114. Maximum allowable working pressures for seamless steel tubes, nipples or flues for water-tube and fire-tube boilers, are tabulated on Technical Data Card No. 113. The Babcock & Wilcox Tube Co.

Valves and Piping

7 Pipe Corrosion—New bulletin, 4 pp., What To Do About Water Pipe Corrosion describes the causes and effect of corrosive waters on iron and brass piping, and, how to overcome and prevent these problems. Water Service Laboratories, Inc.

8 Butterfly Valves—A new 4 pp. bulletin has just been issued on the Phillips Rubber Seated Butterfly Valves whose outstanding feature is that they are "bottle tight." Henry Pratt Co.

9 Pipe Hangers—Adjustable steel pipe hangers, pipe covering protection saddles, radiator hangers, concrete inserts and pipe hangers are covered in a new 8 pp. catalog No. 38 showing the complete Crawford line. Crawford Co.

10 Pressure Regulators—Foster Y-Type pressure reducing regulators for steam, air, liquids and gases are described in Catalog 70, Bulletin 7, with photographs and line drawings. The special features are pointed out, operations outlined and an application chart given. Foster Engineering Co.

11 Valves—Where to Use Valves, Drains and By-Passes is the title of a 36 pp. booklet recently released containing information on the construction and selection of all types of valves, as well as the proper application of drains and by-passes. Jenkins Bros.

12 Multiport Valves—Nordstrom Multiport valves, in sizes from ½ to 16 in. for pressures to 3000 lb., are shown in Bulletin V-135. Three-way, 2-port and 3-port and 4-way, 4-port valves are shown for giving 90, 180 and 270 deg. turns. Merco Nordstrom Valve Co.

Electrical Equipment

13 Electric Distribution—Switches, cabinets, panels, ducts, connections, switchboards and other Bull Dog products are shown in condensed Catalog 411. Bull Dog Electric Products Co.

14 **Electric Connections**—A new 20 pp. catalog, No. 11, shows the complete line of Jones electrical connecting devices, including plugs, sockets, terminals, panels, etc. Howard B. Jones.

15 **Electric Motors**—How to Select Small Electric Motors, ⅛ to ¾ hp. for industrial and household use, is covered in a concise table just issued. Westinghouse Electric & Mfg. Co.

16 **Resistors**—A new bulletin just issued describes a new line of Keystone negative temperature coefficient resistors which give a decrease in electrical resistance with temperature increases. Keystone Carbon Co.

17 **Substations**—Portable substations to meet the current demand for emergency power are described in a new 8 pp. booklet B2281, covering units with voltage ratings up to 69 kv. and capacities up to 4500 kv-a. Westinghouse Elec. & Mfg. Co.

18 **Fluorescent Lights**—A new 4 pp. bulletin describes the use of fluorescent lighting equipment for homes, stores and factories. Allied Radio Corp.

19 **Motors**—Bulletin GEA-3580 gives highlights on the design, construction and application of Tri-Clad motors, showing how extra protection has been built in. Features are cast-iron frame and end shield, stator windings of Formex wire to protect against electrical breakdown and a new design of bearings for protection against operating wear. General Electric Co.

Power Transmission Equipment

20 **Couplings**—Bulletin No. 8100, 19 pp. illustrates and describes the features of five types of Airflex Couplings, and discusses the Airflex Coupling "Rubber Loading in Shear" principle. The Falk Corp.

21 **Belts**—Catalog Section 2150, Selection and Maintenance of Rubber Transmission Belts, answers such questions as: What type? What grade? What width? What thickness? What horsepower capacity? What length? Also covers the importance of bearing capacity in rubber belts, belt joints, endless belts, belt dressing, cleaning, storing, static, oil, and salvage, with definite suggestions for maintaining belt records. The B. F. Goodrich Co.

22 **V-Belts**—Pictorial presentation of construction and uses of Veelos Adjustable belts is given in the 24 pp. Veelos Picturegraph just issued. Manheim Mfg. & Belting Co.

23 **Bearings**—Defense efforts in connection with Timken bearings on aircraft, gun mounts, tanks, trailers and trucks, are described and illustrated in a 32-pp. book. It also covers tooling and equipment to produce the bearings. Timken Roller Bearing Co.

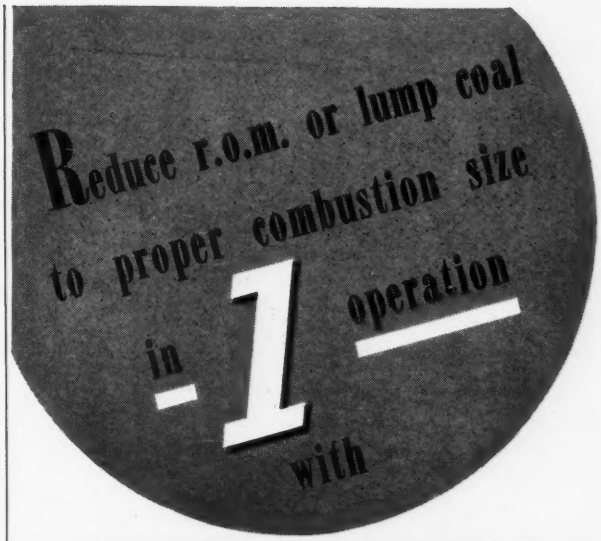
Instruments and Controls

24 **Water Treatment**—Bulletin TOU-6, 19 pp. gives details of equipment for adjusting feed of chemicals, from pumps, meters and solution tanks to boiler feedwater, also for control of flow of product fluids and of expensive liquids and gases. Proportioneers, Inc.

25 **Automatic Control**—Stability in Automatic Control Equipment is a comprehensive treatise on the causes and evils of hunting, the over-shooting and under-shooting, that often results when a time lag is introduced in automatic control of combustion, pressure, turbine speed, temperature, etc. It shows how this hunting problem can best be corrected and true stability attained without sacrifice to sensitivity. Askania Regulator Co.

26 **Oxygen Recorder**—Bulletin DW-2 illustrates and describes the new M.S.A. Oxygen Recorder for measuring and recording oxygen in other gases, excess air in flue gases and air in gas transmission systems. It can be calibrated for any range desired within 0 to 20.8 per cent. Parts of the Recorder are assembled on a steel panel measuring 30 in. wide and 7 ft. high. Mine Safety Appliance Co.

27 **Radio Noise Elimination**—A new 8 pp. bulletin, Radio Interference Elimination for Public Utilities, recently issued, includes a complete description of the causes and cures of radio interference on transmission and distribution lines. Also described is the new Model IL-2 Sprague Interference Locater, redesigned to meet the needs of the public utility trouble shooter in locating and isolating radio interference sources, also for use in locating underground pipes and conduits. Sprague Products Co.



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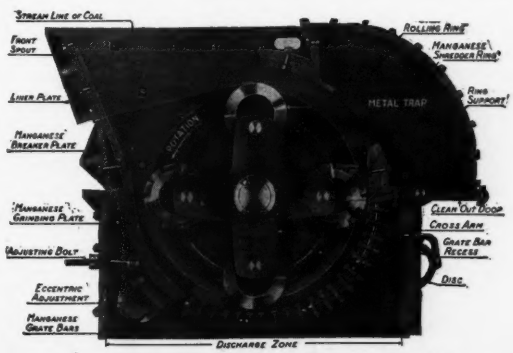
One of the surest and most economical ways to get the better coal sizing you need to reduce steam generating costs is to install AMERICAN Ring Crushers. They reduce in one *operation* run-of-mine or lump coal to the proper sizes for unit pulverizers and automatic stokers.

As shown in the view below, the "AMERICAN" differs from any other type ring crusher. Feed entering the top is rolled by the rings in a downward movement against the breaker plate where primary reduction takes place. Final reduction is accomplished against an adjustable grinding plate where any oversize is eliminated by grate bars or screen plates.

GUARANTEED PERFORMANCE

The many successful installations of "AMERICANS" in industrial plants, central stations and service establishments of all kinds are the result of the thoroughness with which our engineers study individual plant requirements before making a recommendation. On the basis of our recommendations, "AMERICANS" are guaranteed for definite performance. Let us cooperate on your coal crusher problems.



Cross-sectional view of American Ring Crusher

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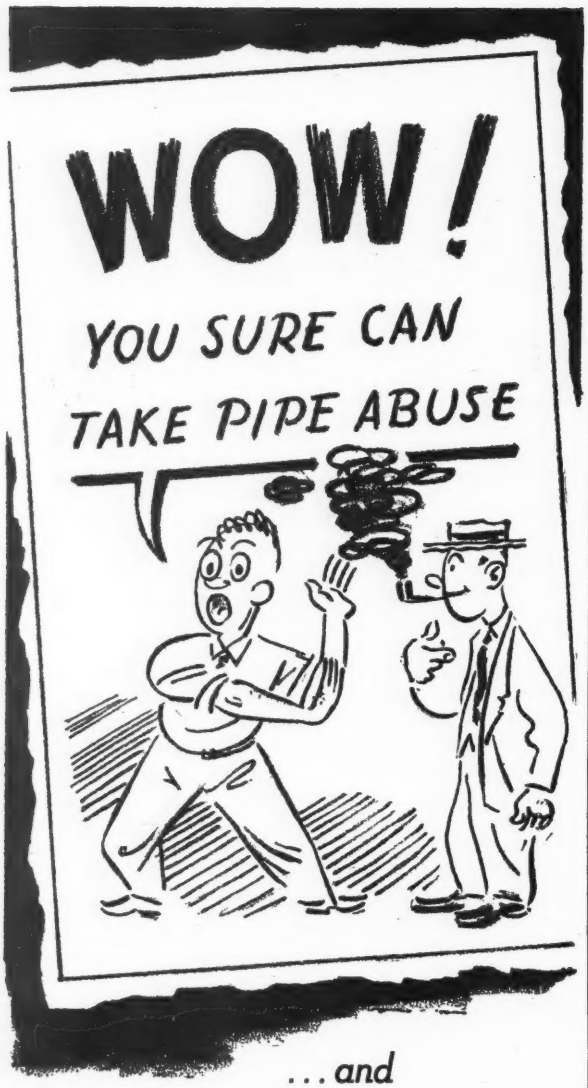

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It's because Dart Unions have matched bronze seats, ground to accurate "true-ball" surfaces that they can make up tight so quickly, stay tight so much longer and can be re-installed so many times. And it's because the nuts and bodies of Dart Unions are made of air refined malleable iron that this equipment can put up such strong resistance to pipe strains, abuse and corrosion.

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Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

28 Meters—Use of graphic meters of all types (electric, pressure, velocity, time, etc.), to regulate processes and detect wastes are described in a "Crime Series" of booklets which shows savings effected. Esterline-Angus Co., Inc.

29 Stroboscope—Two 4 pp. bulletins, A Magic Eye and Strobomeca, describe the application and construction of a new spring wound stroboscopic tachometer, the size of a baseball, to "stopping" all forms of rotary motion. Basic speed ranges run from 500 to 8000 and 1000 to 16,000 r.p.m. Boulin Instrument Corp.

30 Control System—Bulletin 567, 8 pp. describes the experience of a user of Bristol's Automatic Dye-Vat Control System. Ten benefits from this system of control are briefly outlined. The Bristol Company.

31 Telemeter—For recording tie line loads, Bulletins 565, 515A and 513 describe the Metameter system of telemetering and show application to a system spread over some 1000 mi. of territory; The Metavane system for plant metering of temperatures, pressures, liquid levels and flow is also covered. The Bristol Co.

32 Recorders—Bulletin 570, recently released, describes strip-chart recorders for measuring and recording on a 6-in. strip chart, d.c. amperes and milliamperes, d.c. volts and millivolts, pressure, liquid level, flow, mechanical motion, also for remote recording. The Bristol Co.

33 Flowmeters—A series of bulletins describe the construction, uses and performance of Rotameter flow meters. Each section treats of one type and the section desired should be specified. These sections are: Section 10-A on Sight Flow Meters, principles, construction and application; Section 20-B on Post Type for severe use in process industries: Section 30-C on Case Type for case mounting with vertical or horizontal connections; Section 31-D on the Laboratory Type for table use in laboratory work; Section 43-D on the Armored Type in which tubes are enclosed against hazards: Section 63-F covers Aviation instruments for fuel and other fluid flow; Section 80-A explains the theory of the Rotameter and gives charts of performance, capacities and correction factors; Section 39-B on Bypass Orifice Meters for lines where large flows must be measured; a separate bulletin describes Bull's Eye sight flow indicators of various types for ½-in. to 4-in. lines. Fischer & Porter Co.

34 Smoke Control—Photo-electric smoke indicators with and without smoke control are described in a new 4 pp. Bulletin 542. Rehtron Corp.

35 Coal Storage—Spontaneous combustion in coal storage piles and how to protect and guard against it by means of the Hot Spot Indicator and alarm is the subject of a recent two page bulletin. Coal Specialties Co.

Miscellaneous Equipment

36 Lubrication—The Alemite Progressive Lubricating System for all types of industrial machines is described in detail in a new 8 pp. bulletin in color. Alemite Division of Stewart-Warner Corporation.

37 Pumps—Worthington duplex plunger power pumps are described and illustrated (with capacity and dimension tables) in Bulletin W-412-B30. Worthington Pump & Mach. Corp.

38 Pumps—The improved Peerless Hydro-Foil propeller type pumps for handling large volumes of water are described in a new Bulletin No. 148. Peerless Pump Co.

39 Compressors—Bulletin 193 shows features of Pennsylvania air and gas compressors. Pennsylvania Pump & Compressor Co.

40 Diesels—New booklet, What Users Say About Caterpillar Diesel Power, Form 6636, tells of problems solved by Diesel power, installations made, and savings effected in a multiplicity of fields. Caterpillar Tractor Co.

41 Hoists—Catalog H-40 26 pp. describes the construction, operation and application of Lo-Hed monorail electric hoists. Complete with capacities, speeds, heights of lift and specifications. American Engineering Co.

42 Face Shields—Protection for the Eyes and Face is the subject of a 4 pp. circular featuring 20 different models of face shields for welding, splash, heat protection, etc. The Boyer-Campbell Co.

43 Concrete Repair—Waterproofing and patching concrete walls and floors is described in an illustrated folder, showing how seepage can be stopped from the inside of cellars, cisterns and concrete. Smooth-On Mfg. Co.

44 **Circulating Fans**—For halls, large stores and offices, Lincoln fans of various types are shown in a new bulletin. Allied Radio Corp.

45 **Condenser Tubes**—A new 56 pp. catalog, Tubes and Plates for Condensers and Heat Exchangers, covers corrosion factors, alloys for tubes and plates, methods of manufacture, uses in power and industrial plants, installation of tubes, physical properties and tabulated tube data. The American Brass Co.

46 **Ammonia Condensers**—Worthington-Carbondale condensers and coolers, in shell form, vertical and horizontal types, are described in Bulletin C-1100-B13. Worthington Pump & Mach. Corp.

47 **Tools**—The Universal Slotmaster with parts and tools is described in a new 4 pp. bulletin. The slotting head can be used on all milling machines to provide double duty facilities at minimum cost. Experimental Tool & Die Co.

48 **Mailing Data**—A recently released 12 pp. bulletin gives data on mailing lists and selected names of prospective buyers in Latin America, also a list of products exported by the United States to Latin America. Latin America List & Information Service.

Special Request Catalogs

Paint—A new 26-pp. catalog entitled Facts About White Paint and Better Illumination, thoroughly analyzes the effect of paint on lighting and illumination. Included in the catalog are charts showing the coverage of various types of paint, the loss in reflection value with time. Copies sent to plant executives only and requests must be made on company letterhead. Sherwin-Williams Co.

Air Filters—A new 44-pp. catalog, illustrates and describes all the very latest Staynew and Protectomotor Filters for compressed air, gases, liquids, engine and compressor intake, and for building ventilation. Requests for catalog must be on business letter heads. Staynew Filter Co.

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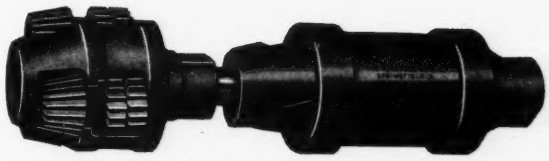

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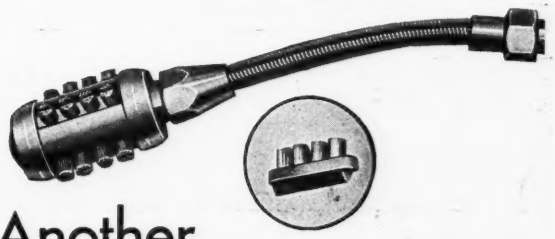

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Power Plant Construction News

Calif., Los Angeles—B. F. Goodrich Co., 5400 East Olympic Blvd., manufacturer of automobile tires and other rubber goods, plans installation of electric power equipment in new one-story addition, 160 by 480 ft. Cost estimated over $200,000. William Mellema, 166½ Beverly Blvd., is architect.

Conn., Hamden—Acme Wire Co,. has plans maturing for addition to boiler house. New boiler unit and auxiliary equipment will be installed. Wescott & Mapes, Inc., 139 Orange St., New Haven, Conn., is consulting engineer.

Conn., Naugatuck — United States Rubber Co., Inc., 1230 Sixth Avenue, New York, N. Y., plans installation of electric power equipment in new mill, for production of synthetic rubber in vicinity of present plant at Naugatuck, to comprise several one and multi-story units. Output will be for Government, which will provide fund of about $1,250,000 through Defense Plant Corporation, Washington, D. C.

Fla., Jacksonville—City Commission plans expansion and improvements in steam division at main municipal electric power plant, with installation of new boiler units and accessories. Cost reported close to $2,000,000. It is proposed to arrange a Federal grant of about $900,000.

Ga., Sylvania—City Council has been authorized at special election to arrange bond issue of $30,000, for improvements in municipal power station, including installation of new 450-hp. Diesel engine-generating unit and auxiliary equipment, previously referred to in these columns. Proposed to carry out work soon.

Ill., Chicago — Ford Motor Co., 12600 South Torrence Ave., plans extensions and improvements in power house at local assembling works, including installation of a turbine-generator unit and auxiliary equipment. Shreve, Anderson & Walker, Marquette Bldg., Detroit, Mich., architects and engineers.

Ky., Louisville — Hydro-Carbon Chemical & Rubber Co., subsidiary of B. F. Goodrich Co., Akron, O., plans installation of electric power equipment in new plant at Louisville for production of synthetic rubber for Government, which will provide a fund of about $1,250,000 for project. Plant will comprise several buildings. A steam power house will be built.

La., Monroe—City Council will receive bids until July 8 for boiler unit and auxiliary equipment for installation in municipal electric power plant, where expansion and improvements will be carried out. A bond issue of $875,000 recently was approved for entire project, including electrical distribution lines. Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., is consulting engineer.

Mich., Detroit—Chrysler Corp., 341 Massachusetts Ave., plans installation of electric power equipment in new addition to automobile works on Kercheval Ave., 240 by 520 ft. Work will begin at once. Cost reported over $400,000. Company also will expand power plant at same works.

Minn., Red Wing — Rock Wool Corp., Red Wing, plans installation of electric power equipment in new one-story mill for production of insulation specialties. Entire project will cost about $100,000. Proposed to begin work at once.

Minn., St. Paul—Northern States Power Co. of Minnesota, Inc., is considering plans for expansion and improvements in Hi-Bridge steam-electric generating station, including installation of new turbine-generating unit, high-pressure boiler and auxiliary equipment. Cost estimated close to $3,500,000.

N. H., Dover—American Woolen Co., Dover, plans early rebuilding of

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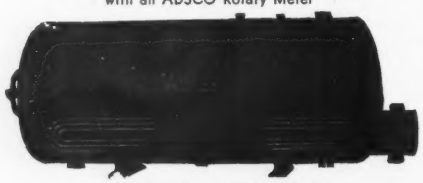

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portion of boiler house at mill, recently damaged by fire from a boiler explosion. Loss reported about $35,000, with equipment.

N. J., Garfield—Heyden Chemical Corp., Garfield, plans new power house for service at chemical works. Cost reported close to $300,000, with equipment.

N. J., Rahway—Merck & Co., Inc., East Lincoln Ave., will soon award contract for structural steel framing for new boiler house at local chemical and drug works. Cost reported over $60,000, with boiler units and auxiliary equipment.

Ohio, Cincinnati — Magnus Metal Div., National Lead Co., 659 Freeman Ave., plans installation of power equipment in new two-story plant at 1001 West Seventh St. Cost reported over $275,000. Work will be placed under way at once. Olsen & Urbain, 8 East Huron St., Chicago, Ill., architects. Main offices of company are at 111 Broadway, New York, N. Y.

Ohio, Cleveland—E. I. duPont deNemours & Co., Inc., 2615 Independence Road, plans addition to power plant and pumping station at local chemical plant. Bids are scheduled to be asked soon. Company engineering department, duPont Building, Wilmington, Del., is in charge.

Okla., Norman—State Board of Affairs, State Capitol Building, Oklahoma City, has secured appropriation of about $55,000, for extensions and improvements in steam power house at Central State Hospital, Norman, include installation of new boiler unit and accessories. Plans will be prepared soon.

Okla., Vinita—Grand River Dam Authority, Vinita, T. P. Clonts, general manager, plans installation of electric power equipment in proposed new magnesium reduction plant. Site is being selected. Plant will comprise several large units and is reported to cost over $10,000,000, with financing to be arranged through Government. Transmission lines will be extended from hydroelectric generating station of Authority, near Pensacola, Okla., to plant site, where large power substation will be installed.

Pa., Grove City—Borough Council plans expansion and improvements in municipal electric power plant, with installation of additional equipment. Also will make extensions in electrical distribution system. The Chester Engineers, Inc., 210 East Parkway, Pittsburgh, Pa., is consulting engineer.

Pa., Petrolia — Pennsylvania Coal Products Co., Petrolia, has approved plans for new boiler house at plant. Cost reported over $45,000, with boilers and auxiliary equipment. Joseph Breslove, Oliver Bldg., Pittsburgh, Pa., is consulting engineer.

Pa., Seward—Pennsylvania Electric Co., Johnstown, Pa., has plans under way for addition to power plant at Seward, primarily for expansion in steam department, with installation of new boiler units and accessories. E. M. Gilbert Eng. Co., 412 Washington Street, Reading, Pa., is consulting engineer.

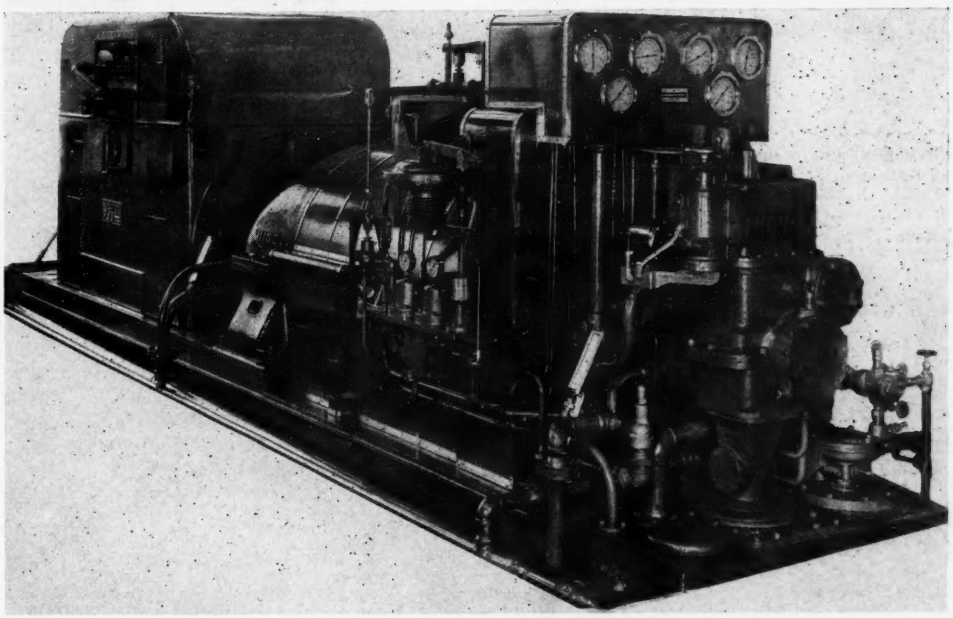
Pa., Williamsburg — Pennsylvania Edison Co., Altoona, Pa., plans extensions and improvements in steam-electric generating station at Williamsburg, including installation of new 25,000-kw. turbine-generator unit, high-pressure boiler and auxiliary equipment. Cost reported close to $3,000,000, including transmission line extensions.

S. C., Charleston—Charleston Shipbuilding & Drydock Co., plans installation of electric power equipment in connection with expansion and improvements in shipbuilding plant, including shipways, shops and other structures. Proposed to increase and improve boiler house. Entire project reported to cost over $300,000. Dotterer Eng. Co., 21 Broad Street, Charleston, is consulting engineer.

Wash., Seattle—Sterling Theatres, Inc., Palomar Bldg., plans installation of boiler plant for central-heating service in new theater building at California Ave. and Admiral Way, West Seattle. Entire project will cost about $200,000. Work scheduled to begin in July. B. Marcus Priteca, Palomar Bldg. is architect.

W. Va., Alloy—Electro Metallurgical Co., Union St., Niagara Falls, N. Y., a subsidiary of Union Carbide & Carbon Corp., 30 East Forty-second Street, New York, N. Y., plans installation of electric power equipment in group of new additions to branch plant at Alloy. Cost reported over $400,000. Work will begin at early date.

MURRAY TURBOGENERATOR



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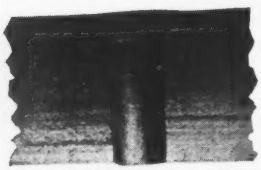

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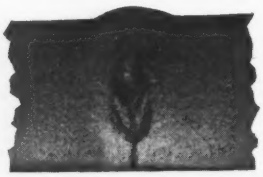

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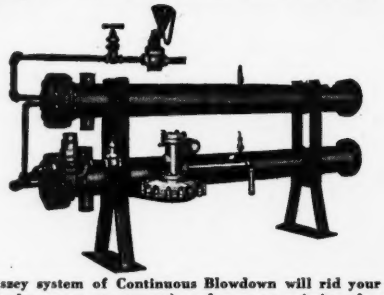

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